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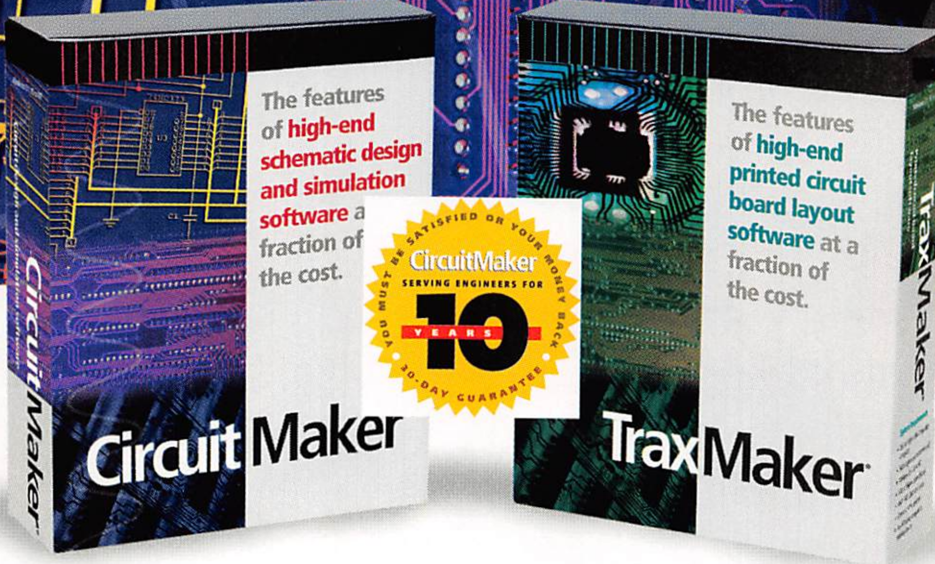

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EDITORIAL

Of Edsels And DIVX

With much noise and promise, DIVX (DIgital Video eXpress) was introduced in September 1997. It died with a whimper on June 16, 1999.

RIP, and good riddance.

Oftentimes good marketing can sell a product with no or marginal appeal, or allow a product that is technically inferior to sell better than one that is technically superior. Among videophiles, one often sees the VHS *vs.* Beta format war as an example of that. What they forget, however, is that VHS had a feature—longer recording time—that most consumers wanted. In this case, convenience was more important than a superior image. By the time the Beta camp realized this, VHS had gotten too large a jump and the war was over.

Here, DIVX was counting on convenience winning out again. The problem was that DIVX was not all that convenient. Sure, you could buy the disc, watch it for 48 hours, and then throw it out. But the discs were expensive ($4.50 for the first 48 hours as opposed to $2.99 to $3.50 for two- to five-day rentals at national chains), hard to find outside of Circuit City (part owner of the DIVX format) stores, and (because of the amount of data required to implement DIVX's extra encryption) lacked many of the special features (trailers, out-takes, actor interviews, etc.) that DVD viewers have come to expect. Add to that the fact that the hardware cost about $100 more than an equivalent open-standard DVD player and that the system needed a telephone connection to work and you have a lose, lose, lose proposition—and it lost, big time. The press release announcing the end of DIVX stated that the after-tax loss to Circuit City will be $114 million.

Fortunately, those who purchased DIVX players will not share in the loss. In a very smart business decision, the DIVX consortium (*i.e.* Circuit City) is offering a $100 cash rebate to anyone who purchased a DIVX-enhanced player prior to June 16, and the players can be used to play normal open-standard DVDs. DIVX discs can be viewed until June 30, 2001. Consumers who upgraded any discs to unlimited viewing can receive a refund of the upgrade price; DIVX will not upgrade any new discs. Rebate forms will be available at www.divx.com, participating retailers, and by calling 888-639-DIVX.

In conclusion, DIVX claimed in their farewell news release that the format died due to lack of retailer/studio support and despite "significant consumer interest." Nonsense. It died because it was a product that consumers did not want, as evidenced by the relative sales figures. And it died because the forces behind DIVX forgot one important marketing principle:

Most consumers recognize an Edsel when they see one.

Carl Laron

Carl Laron
Editor

LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

Successful Soldering

I've heard and seen several interesting comments regarding my article "How to Succeed in Soldering" (**Electronics Now**, July 1999) that need to be addressed. As I expected, not everyone agrees with my methods; and as I stated in the article, my methods were only for those who weren't achieving **consistently** good results. We can lump the comments into two main categories: temperature control and fluxes.

It appears that many people are "in love" with their temperature-controlled soldering stations—I would be, too, if I had spent that much money! The main attraction seems to be "that the soldering tip lasts a lot longer" when idling at low temps. When I'm in a soldering "siege," my pencil iron idles flat-out all day long. My tips always last for at least a year. As the article stated, tip maintenance is the key issue here, as well as using the correct flux—bringing us to the second group of comments.

Some hobbyists have found what they feel are more effective fluxes than the rosin-core specified in my article. Others really enjoy removing (by whatever method) every bit of flux residue from their boards—more power to you! As you know, I consider flux removal a task that yields limited returns. The risk of contaminating non-hermetic components on your board is a serious problem that usually rears its ugly head as soon as the ambient humidity changes.

One hobbyist has used water-soluble flux for many years with good results. I've also used this type of flux in industry, and the fact of the matter is that the fluxes have to be thoroughly removed from your finished product. They are so active that any residual flux will sooner or later corrode any metal they contact. Unfortunately, there is no way to clean this flux from beneath a solder joint, and right there is where I've spent many hours repairing circuit board traces!

The article clearly stated that if you already have a good soldering method, then by all means don't change it! My method works for me, and I'll stand by it—but my method may not work well for everybody!

SKIP CAMPISI

At last, someone who knows how to solder efficiently! I have been an electronics hobbyist for 29 years and a professional technician for 24 years. The article "How to Succeed in Soldering" (**Electronics Now**, July 1999) is the one article I have seen, including my Tech School text books, that shows the "proper" method of making a solder joint, i.e., using a hot iron and applying the solder to the iron first to speed up heat transfer. I have used this method all of my career with only a slight change. I use a 47-watt iron, and my average joint is made in under one second. Well done, Mr. Campisi.

PAUL STEPHANY
Sergeant Bluff, IA

. . . and MixMaster Cautions

Thank you so much for your "How to Succeed in Soldering" article (**Electronics Now**, July 1999). Like Mr. Campisi, I have been a home experimenter for over 35 years and a pro for most of that time, but he has given me a few helpful hints. For someone who does a lot of soldering and has an iron running for long periods of time, a 40-watt or so iron, temperature controlled at 650°F to 700°F, provides plenty of reserve heat when needed without "burning up" tips when idle. Digital display, microprocessor control, and regulation to within ten degrees are overkill, but I find Weller's WTCPS soldering station, a simple magnetic-mechanically controlled arrangement, to be a worthwhile investment.

In the same issue, the article "DJ MixMaster" contains several useful and unique techniques, but it could pose some problems. First, in Fig. 3, p. 35, gain controls R116-a and R116-b drive output jacks J15 and J16 directly. The effective output impedance could be as high as 50,000 ohms, which may cause high frequency loss and hum if the cables to the power amplifier are more than a few feet long. Also, some PA power amplifiers have an input impedance of 10,000 ohms or so, which could severely upset the action of the 100,000-ohm controls. As a precaution, I would add another NE5532 stage between the controls and the output jacks to serve as a unity gain buffer.

Also, regarding the XLR connectors, the drawing of the microphone input connector, J18, (Fig. 2, p. 34) is misleading because the center pin is not ground. Additionally, resistors R119 and R120 (600 ohms) are not standard available values; as 1% metal-film units are specified for those, the closest standard value would be 604 ohms.

Last but not least, most public address speaker systems (the two or so cubic-foot cabinet housing a 12-inch cone speaker plus a compression horn) generally only have a frequency response from 80 Hz to 12 kHz. Boosting frequencies outside this range at high volume levels will only cause distortion, overheating, and possible damage. On any PA audio system I work on, I check the manufacturer's specifications regarding the speaker frequency response and use the equalizer to restrict the bandpass of the electronics accordingly.

MICHAEL KILEY
Crestwood, IL

EN

Write To:
Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

Adding IrDA Interface

Q *My Biostar PC motherboard has a connector for an IrDA infrared transceiver. There are four wires, +5V, GND, IRRX, and IRTX. I assume the latter two are infrared receive and transmit respectively. There is no infrared LED or photodiode. What do I need to add in order to be able to use IrDA?—A. G., Washington, DC*

A First make sure that the IrDA UART (universal asynchronous receiver-transmitter) is really on the motherboard—that the chips haven't been left off. The way to tell is that if the UART is there, Windows 95 and 98 will detect the IrDA hardware and let you install IrDA drivers, which you can get from your installation disk or from www.microsoft.com. The drivers may already be there; check "My Computer, Properties" carefully.

Although we don't have the particulars of your motherboard, it appears that what you need to add is an infrared transceiver such as the Hewlett-Packard HSDL-1100-017. This is a hybrid IC that contains the appropriate LED, photodiode, and control circuitry.

Figure 1 shows how it's used. The HSDL-1100-017 itself can transmit and receive data as fast as 4 megabits per second, but its actual speed will depend on the IrDA UART on your motherboard.

You can download a data sheet for the HSDL-1100-017 from www.hp.com/go/ir, which includes a link for ordering this device in small quantities for about $14 each. Bear in mind that it is a tiny surface-mount IC for which you will probably have to make a printed-circuit board. Also, our published circuit is taken from an HP application note, but we have not actually built and tested it, so it's doubly important for you to read the data sheets and understand what you're building.

General information on IrDA (Infrared Data Association) standards and protocols can be obtained from www.irda.org.

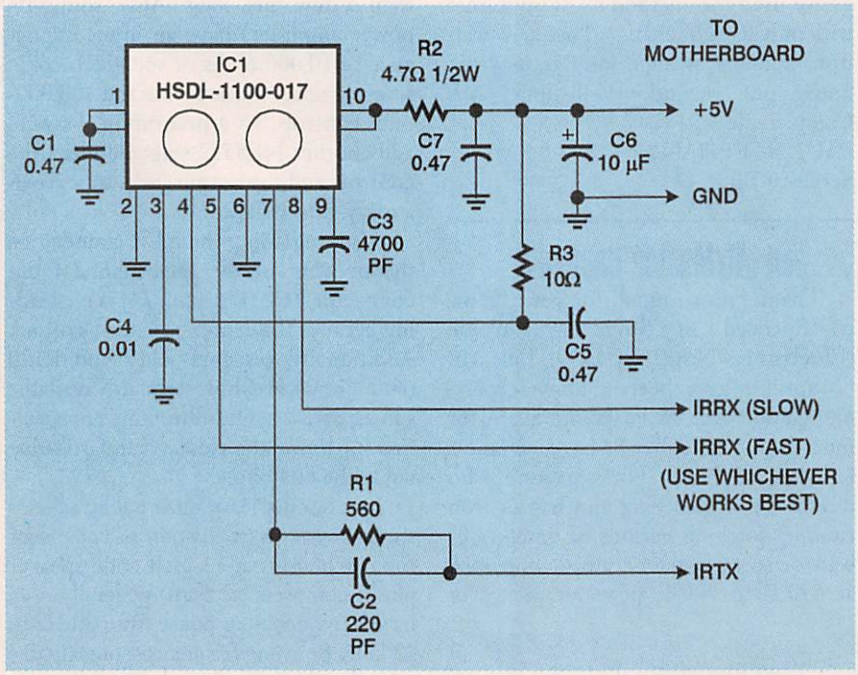


FIG. 1—AN INFRARED TRANSCEIVER, such as the Hewlett-Packard HSDL-1100-017, is a hybrid IC that contains the appropriate LED, photodiode, and control circuitry. This example circuit was taken from an HP application note. Pins 1 and 10 are double pins.

Computer Masquerades As Printer

Q *I have some data files on a Commodore 64 computer and a program that can print them but cannot put them onto a diskette. Can I connect the parallel printer port of my Commodore to the parallel port of a PC and capture the data? Stripping out the printer control codes and other extraneous material is no problem.—D.L.G., Detroit, MI*

A We consulted parallel-port expert Jan Axelson (www.lvr.com), who advised that although modern PC parallel ports are capable of receiving input, you'd be better off converting the data to serial before transmitting it to the PC. The reason is that serial ports have the ability to buffer incoming data, but parallel ports don't; the computer must be listening at the exact moment the data is placed on the port. Thus, data transfer between parallel ports requires cooperation between the two computers.

Figure 2 shows roughly what you need. A parallel-to-serial converter, also known as a Centronics-to-RS-232 converter, would normally be used to connect a computer's parallel port to a serial printer. In this situation, though, you'll be feeding the serial data into another computer. You can do this by writing a program in BASIC to read from COM1 or by running a terminal program such as Kermit and capturing the data received.

Parallel-to-serial converters are available for about $85 from B&B

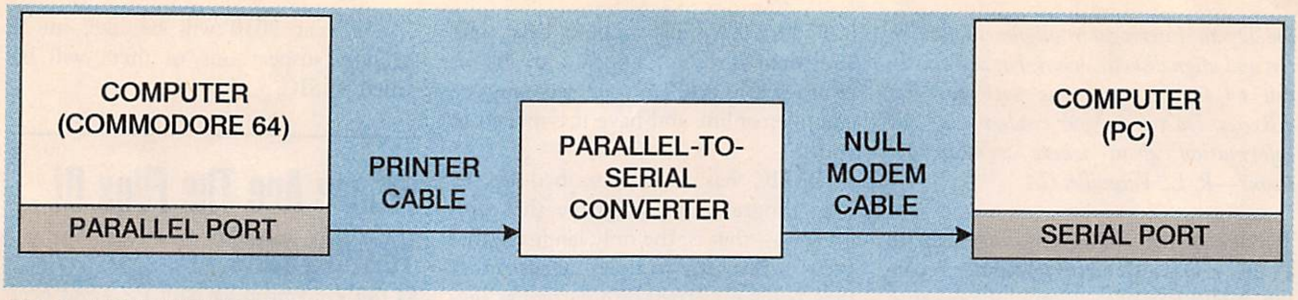


FIG. 2—A PARALLEL-TO-SERIAL CONVERTER could be used as shown here to let one PC capture data being output from another PC's parallel port.

Electronics, 707 Dayton Road, Ottawa, IL 61350; Tel: 815-433-5100; Web: www.bb-elec.com. But before you buy one, ask around and see if there is one you can borrow. Any company with a substantial fleet of PCs has probably used these devices at one time or another. Read the specifications carefully, and be prepared to use a voltmeter or RS-232 breakout box to make sure everything is connected as intended.

Mouse On Parallel Port?

Q *I use a Toshiba T2150CDS laptop computer on my boat with a GPS receiver connected to its serial port. I need to connect an external mouse, but the serial port is not available. Can I connect a mouse to the parallel port?—K. W., Annapolis, MD*

A This runs into the same buffering problem as the previous question: the parallel port has no place to hold data if the PC isn't listening at the exact moment the data appears. Connecting a mouse to the parallel port would require custom device drivers (*i.e.*, rewriting part of Windows) as well as special hardware. Someone may make a commercial product that solves this problem; if so, we'd like to hear about it. Readers?

Making A 220-Volt Timer

Q *There are many commercial 120-volt, 15-amp AC timers on the market, but timers for 220/240-volt circuits are much more expensive. Is there a simple way a handyman can combine two 120-volt timers to make a 220/240-volt timer suitable for air conditioners and the like?—N.H.G., Philadelphia, PA*

A As you note in your letter, a 220/240-volt circuit has two "hot" wires (above ground) that have to be switched simultaneously. Also, 220/240-volt circuits generally carry heavy current (20 to 30 amps) for large appliances.

You could use a 120-volt timer to control a relay with a 120-volt AC winding and 220/240-volt, DPST or DPDT, high-current contacts. Such a relay costs $20 to $40. At that price you'd be better off spending about $60 for a heavy-duty 220/240-volt timer.

Durability is another advantage of the heavy-duty timer; it will run for years without trouble, while a plastic-bodied 120-volt timer is likely to wear out in a couple of years of continuous operation.

Transistorizing A Dip Meter

Q *I have an old Millen 90651 grid-dip meter that uses a type 9002 tube, which is no longer available. Can you suggest a transistor to replace the tube?—J.J.B., Arnold, MD*

A A dip meter, for those not old enough to remember, is an RF oscillator that has a meter showing the amount of feedback. By holding the oscillator coil next to a tuned circuit, you can tell when the two circuits are in resonance because of a "dip" in the meter reading.

The 9002 is a miniature 7-pin triode tube, and it is still available from Antique Electronic Supply, 6221 S. Maple Ave., Tempe, AZ 85283; Tel: 602-820-5411. Replacing it is your simplest option. Unfortunately, no other tube has the same pinout, so a tube substitution probably isn't practical.

If you want to transistorize the meter, reduce the supply voltage to about 20 volts (perhaps feeding the original filament supply into a voltage doubler or tripler) and try an N-channel JFET such as the MPF102 or 2N3859.

Remote-Controlled PC

Q *I have my computer upstairs, with a video card that supports output to a TV set. What I'd like to do is transmit the audio and video from the computer to a TV set located downstairs, and also design a circuit that would enable me to use a keyboard and mouse downstairs in addition to those at the computer. I'd like to use wireless communication if possible.—K. B., USMC*

A Actually, I advise going in a different direction. It's easier, and probably cheaper, to network two PCs than to control a single PC from two locations. Unlike UNIX workstations, PCs are not designed for remote control, but they work well in networks.

A network would let you share files, printers, and even a modem. There are even wireless local-area networks on the market for under $150. Best of all, you don't have to write any software; the necessary drivers are already part of the operating system.

If you insist on using one computer, take a look at Applica U2, a hardware/software package that allows two people to share a single PC running Windows 98, with two screens, two keyboards, and two mice. This is a product of Concurrent Controls, Inc., 349 Allerton Avenue, South San Francisco, CA 94080; Web: www.applica.com. I've seen a PC work well with VGA, keyboard, and mouse cables that were 30 feet long and led into a room on the next floor, so you can presumably run Applica U2 through long cables. As far as I know, Applica U2 does not support wireless communication; for that, you need computers on both ends.

Alignment Diskettes

Q *We refurbish computers for use in California schools. We have been using*

the Dysan Interrogator alignment disk to test and align diskette drives, but our vendor can no longer supply us with the test diskettes. Do you or your readers have any information about where we can get them?—R. L., Vacaville, CA

A Back in the 1980s, aligning diskette drives was a standard computer repair job. Nowadays, it's seldom done because a new drive costs only $30 or so, less than the value of the technician's time to do an alignment. (If you have volunteer or student labor, of course, that's not an issue.) Also, my sad experience in the "good old days" was that if a drive went out of alignment once, it would do so again soon.

Alignment disks can't be copied in an ordinary disk drive, of course, because some of the tracks are deliberately recorded out of alignment. So when a disk wears out, you have to replace it.

Analog and digital alignment disks and software—apparently just like the old Dysan products, although the specifications don't mention Dysan—are still made by Accurite Technologies Inc., 48460 Lakeview Blvd., Fremont, CA 94538-6532; Web: www.accurite.com.

TV Schematics

Q *I am a high school student repairing an RCA television set for a senior class project. Do you have schematics or other information that you can fax me?—A. G., Tecumseh, Ont., Canada*

A Unfortunately, no, we don't provide this service. You can purchase TV schematics from Howard W. Sams; see "How to Get Information About Electronics" elsewhere in this column. Since it's a school project, a TV shop in your town might be willing to help you.

Still Alive And Compiling...

Q *Regarding your answer to R.A.R. in the March issue, PowerBASIC (formerly Turbo Basic) is still alive and well. This compiler is compatible with QuickBasic but outperforms it and has add-ons for Windows programming and DLLs.—Robert Stucker, Kansas City, MO*

A Thanks for the tip. Sure enough, the company can be reached at 316 Mid Valley Center, Carmel, CA 93923; Tel: 800-780-7707; Web: www.powerbasic. com, and their product appears to be as impressive as ever. You can even buy the compiler online and have it e-mailed to you.

BASIC has been described as the only programming language that ever grew up—that is, the only language that grew in response to users' needs rather than being governed by a particular theory of how computer programming ought to be done. As a result, it's *handy* in a way other languages aren't. I don't know what the programming languages of the year 2050 will be like, but I strongly suspect one of them will be called BASIC.

Where Are The Files Of Yesteryear?

Q *I'm experimenting with PICs and have been going through back issues of* **Electronics Now**. *I'd like to download various PIC programs from these earlier magazines but don't seem to be having any luck.*

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at http://www.gernsback.com for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci. elec tronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio. amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at http://www.hitex.com/chipdir/, or try addresses such as http://www.ti.com and http://www. motorola.com (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. www.questlink.com features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from www.icmas ter.com, which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at www.repair faq.org

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1994 only) are available from our Claggk, Inc., Reprint Department, P.O Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (http://www.arrl.org). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

Could you help me find them?—S.T.B., Ellettsville, IN

A Editor Carl Laron responds: "All files that are still available are located on our FTP site, *ftp.gernsback.com/pub/EN*. That includes most files that were on our old BBS, which is now out of service. Unfortunately, before our move to the Internet, the BBS suffered a catastrophic crash, and we lost a few files as a result. If you can't find a file on the FTP site, most likely it is one of the lost ones. In that case, if you let us know which file you're looking for, we'll try to track down a duplicate copy."

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to:

(1) include plenty of background information (we'll shorten your letter for publication);

(2) give your full name and address on your letter (not just the envelope);

(3) type your letter if possible, or write very neatly; and

(4) if you are asking about a circuit, include a complete diagram.

Questions can be sent to Q&A, **Electronics Now** Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mailed to q&a@gernsback.com, but please do not expect an immediate reply (because of our backlog) and please don't send graphics files larger than 100K. Due to the volume of mail, we regret that we cannot give personal replies. EN

BY KONSTANTINOS KARAGIANNIS
COMPUTER EDITOR

Digital-Photo Printers

DIGITAL CAMERAS USED TO COME IN TWO FLAVORS: HIGH-END UNITS WITH HIGH-END PRICES FOR PROFESSIONAL APPLICATIONS, AND LOW-END UNITS STILL WITH HIGH-END PRICES FOR GADGET FREAKS AND THOSE INTERESTED IN capturing images for use on the Web. My, how times have changed.

Seemingly overnight, digital cameras have become all the rage. In recent months tons of new megapixel units have been introduced, and the two-megapixel barrier has been broken by a number of companies including Nikon, Olympus, Agfa, and others. The result is that it is now possible to use a reasonably priced digital camera to produce an image as large as 8 by 10 inches with a quality that will rival a standard photographic image.

Or is it?

An obvious dilemma manifests itself when you think about outputting images from a digital camera: How do you get the image from your camera to paper? This remains the traditional and usually preferred way to share images, after all.

The most common solution is to use a good-quality ink-jet printer. Using special paper and sometimes special inks, ink-jet printers can output images that at first glance appear to be as good as standard photographic prints. Indeed, when viewed from a distance, they are often impossible to tell apart from standard photos. Up close, however, things begin to fall apart. In particular, the output from even the highest resolution ink-jet printers still shows the telltale ink-dot pattern.

To get the continuous tones of true photos a different approach is needed. This month, we'll look at two relatively new consumer printers that deliver true photo-quality output, albeit at just snapshot sizes.

Polaroid Revisited

Our first entry this month is the lightweight *PhotoMAX Digital Photo Printer* from Polaroid. The most startling thing about this printer is that it does not use standard or photo paper as its media. Instead, it uses Polaroid Spectra Film packs and the images that are output are identical to what you get using a Polaroid Instant Camera. And in that fact lie the keys to both this printer's strengths and weaknesses.

VENDOR INFORMATION

Olympus America, Inc.
Two Corporate Center Dr.
Melville, NY 11747
Tel: 800-347-4027
Web: www.olympus.com/digital

Polaroid Corporation
784 Memorial Drive
Cambridge, MA 02139
Tel: 781-386-2000
Web: www.polaroid.com

Polaroid film is, well ... Polaroid film. If you like the look of Polaroid images (or at least don't mind them), you will be satisfied with the output of this printer (actually you might very well like it better for reasons we'll explain in a moment). If you hate it, it is unlikely that this printer will be on your next Christmas list. But regardless of what your feelings about Polaroid images are, keep in mind that the format is extremely popular with families and for certain business applications, such as photographing real estate. And also keep in mind that this is about the only consumer-accessible solution to date that allows you to get true "photographs" from a digital camera.

POLAROID'S PHOTOMAX DIGITAL-PHOTO PRINTER will let you create real photos in about 30 seconds. If you're happy with the quality of actual Polaroid shots, consider the PhotoMAX, which is available for less than $300.

To use the printer, simply plug it into the parallel port of any PC, install the included drivers, drop in a film pack, and you are set to go. To process the output from your digital camera the printer is bundled with two Polaroid PhotoMAX image-processing programs. *PhotoMAX 2.0* is the more basic package and is aimed at the family/fun user as it includes templates for using your digital photos in calendars, Web sites, e-mail, and more. It features an "Instant Print" feature that when selected automatically pre-processes your digital image for clarity and sends it to the PhotoMAX

printer. *PhotoMAX Pro* is aimed at the business user and includes templates for using your images in business cards, brochures, etc. While either package is suitable for basic editing, if your needs are more extensive or you have more experience in this area and are already comfortable with other image-editing software, the PhotoMAX printer is compatible with any TWAIN-compliant software or hardware.

One major advantage of getting your Polaroid prints via the digital route is that it frees you from the limitations of the standard low-end Polaroid film cameras. To keep costs down, these cameras typically offer only limited control over a photo's parameters, and acceptable but far from stellar optics. When you go digital, however, you are free to use any digital camera. Combine that with post-shot image correction and editing with the software of your choice, and the results can be startlingly good—better than you might have believed possible using this format.

The suggested retail price for the Polaroid PhotoMAX printer and PhotoMAX image-processing software bundle is $299. It will be available through mass-market retailers.

Olympus In An Instant

The second unit we looked at this month is the *Olympus P-330 Instant Home Printer*. The P-330 is a true dye-sublimation printer that produces 4- by 5.5-inch continuous-tone color prints using a proprietary ribbon and photo-paper process. The successor to Olympus' popular P-300 model, still available as of this writing, this new unit offers several cutting-edge features.

First of all, it directly reads SmartMedia cards. Those cards are the storage media used by Olympus cameras as well as by those from many other manufacturers including Agfa, Toshiba, Fuji, and more. That allows you to do two things. One, if you hook up a TV or monitor to the printer, you do not need a computer to process your digital images. Controls on the unit allow you to scroll through recorded images, select the one you want to print, select how many copies of that image you want to print, and do some very rudimentary image editing (enlarge and crop, mirror, and adjust sharpness). You can also elect to print up to 16 of the same image on a single sheet or on the available sticker photo paper (which comes in 1-, 4-, and 16-sticker versions).

The second thing that the ability to read the SmartMedia cards does is allow you to use the printer as a SmartMedia drive. That means you can copy the contents of the card to your computer's hard drive (through a parallel-port connection) and then erase the card for continued use. In our testing, the speed of the

FOR IMAGE PRINTS THAT LOOK LIKE ORDINARY SNAPSHOTS, check out the Olympus P-330. Though pricier than the Polaroid unit we review here, the P-330 is more versatile and provides stunning photo-quality output.

transfer seemed to be a bit quicker than using the "flashpath" adapters that are popular for this application, although we did run into one hang-up. Our test machine was an older Pentium with an apparently older version of the Windows virtual printer driver (LPT.VXD). Because of that situation, the driver for the file-transfer refused to work, and we had to turn off bi-directional support to get the printer to work at all with the computer. Once we upgraded the virtual printer driver, everything worked flawlessly.

Another important feature of the unit is that it has an NTSC video input, which allows it to act as a video frame grabber, capturing images directly from a VCR, DVD, camcorder, or any other standard source.

Finally, if you own an Olympus D-500L, D-600L, or D-620L digital camera, you can connect that camera directly to the unit for computer-less image printing.

The printer hooks up easily to a PC or Mac. On the PC, the P-330 appears as a standard Windows printer and hence can be used with virtually any image-processing software. The driver also has settings that allow you to make basic adjustments in color, sharpness, and density.

Ease of use in all modes is outstanding. We were happy to find that this is so, because the supplied manuals are just awful—not an uncommon problem with gear of this type.

And what about the picture quality? In a word, it is stunning. The printer produces 24-bit color depth (16.7 million colors) and continuous-tone images at a resolution of 306 dpi (equivalent to 2400 dpi on an ink jet). To most people, the images would be indistinguishable from regular photo snapshots, though this reviewer feels he'd be able to tell the difference.

Most prints in the P-330 are made in a three-pass process. However, Olympus has also recently introduced a four-pass ribbon that adds a UV-resistant overcoat to the images (the printer automatically detects whether a three- or four-pass ribbon has been installed).

The P-330 has a suggested retail price of $449, though street prices, as always, are lower (around $400 at last check). Media must be purchased separately (only a 10-print sample pack is included). The paper and ribbon are only sold together; the standard 3-pass paper kit lists for $39.99 (again, street prices are lower) and comes with enough ribbon and paper for 60 prints (which comes out to $.66 per print, or less). Sticker and four-pass media are of course higher.

And that wraps up another column. As always, if you'd like to get in touch, please feel free to send e-mail to connections@gernsback.com, or snail-mail to *Computer Connections*, **Electronics Now**, 500 Bi-County Blvd., Farmingdale, NY 11735. **EN**

BY DON JENSEN

Walking The Plank

FOR YEARS NOW, UNLICENSED OR PIRATE SW STATIONS HAVE BEEN WITH US. WHILE TRADITIONALLY, THESE ILLICIT BROADCASTERS HAVE BEEN THOUGHT OF AS JUST "KIDS PLAYING RADIO," TRUTH BE KNOWN, MOST OPERATORS ARE adults who know, or should know, the law.

It's not difficult to be a SW pirate. To go on the air, albeit illegally, a pirate needs no more than an old "ham" transmitter, a simple antenna, and a makeshift studio.

Some do it for the adventure, for the fun of "getting away with it." Some do it to impart their "message" to the world, be it legalization of marijuana or disdain for authorities that would curb their "free speech." Some do it to put their own personal stamp on radio programming, airing what they see as "alternative" radio.

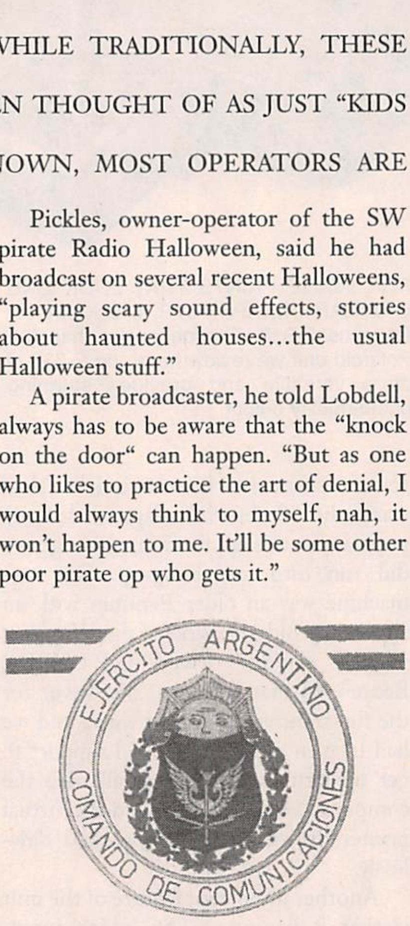
Most of the time they get away with it, because their pirate broadcasts—many of them in the 6900 to 7000 kHz range—are occasional and sporadic, but also because the Federal Communication Commission's attempts to crack down seem equally haphazard. But, for radio pirates, there's always the real possibility of getting caught and perhaps paying a hefty fine that can run in the thousands of dollars.

"Tommy Pickles" is an ex-pirate broadcaster whose story recently appeared in Chris Lobdell's "Pirate Radio Report" in *The Journal of the North American Shortwave Association.*

CREDITS: Brian Alexander, PA; Bob Fraser, MA; Mark Humenyk, ONTARIO; Fred Kohlbrenner, PA; David Krause, OH; Jerry Lineback, KS; William McGuire, MD; Betsy Robinson, TN; Bill Smith, TX; North American SW Association, 45 Wildflower Road, Levittown PA 19057.)

Pickles, owner-operator of the SW pirate Radio Halloween, said he had broadcast on several recent Halloweens, "playing scary sound effects, stories about haunted houses...the usual Halloween stuff."

A pirate broadcaster, he told Lobdell, always has to be aware that the "knock on the door" can happen. "But as one who likes to practice the art of denial, I would always think to myself, nah, it won't happen to me. It'll be some other poor pirate op who gets it."



A VERIFICATION REPLY from LRA36, Radio Nacional Arcangel San Gabriel, which recently installed a long-awaited new and more powerful shortwave transmitter in Antarctica.

Last year, Pickles was ready to go, his Halloween broadcast recorded in advance, and his transmitter tuned up and tested on the air. The latter, he concedes, may have been his crucial mistake, giving FCC engineers a chance to get a "fix" on his location. The Halloween broadcast went off without a hitch, but about 20 minutes later, his son informed him that there were a few men at the door.

"Radio Halloween had been busted," Pickles recounted. The FCC agents gave him a warning notice of violation. This was followed by a formal notice by registered mail.

"Fortunately," Pickles said, "no fines were assessed. To the best of our knowledge, we were not interfering with any other legal transmission. Anyway, after telling us what we were doing was illegal, they left."

"Radio Halloween is no more," the pirate broadcaster concluded. "The transmitter has been sold and the studio dismantled."

One pirate, at least, has walked the plank.

A Mideast SW Catch

It's oil that fuels the United Arab Emirates, a small independent Middle Eastern nation that pokes its peninsular finger into the Arabian Gulf toward Iran, its much larger neighbor across the narrow waterway. And, though petroleum prices have sagged of late, the UAE still holds the record for the world's highest per capita income–some $19,000 per person!

It is an interesting yet not well-known country, and home to two equally interesting shortwave voices: UAE Radio from Abu Dhabi and UAE Radio in Dubai.

The UAE dates to December 1971, when seven emirates—Abu Dhabi, Dubai, Sharjah, Ras al Khaimah, Umm al Quwain, Ajman, and Fujeirah—joined together for self-protection in the volatile Mideast region. Abu Dhabi City is the capital of the UAE.

The UAE's population is more than 1.5 million, many of them employed in the oil industry. When stability returns to the region, the UAE's tourism potential is bright with its subtropical climate, blue waters, and wonderful beaches. Topographically, it ranges from the northern mountains to the impenetrable desert in the south. Arabic is the official language of the UAE, but English is widely spoken.

Abu Dhabi is a modern, cosmopolitan city on an island just off the coast of the peninsula. It is home to one of the UAE Radio shortwave stations, which went on the air as Abu Dhabi Radio in 1969, some two years before the establishment of the union of emirates. In those days, the station aired six hours daily of Arabic-only programming.

With the formation of the UAE, the SW voice assumed its present name. In the more than a quarter century since, the station broadened its operation and facilities but still focuses its programming efforts toward serving Arabic-speaking listeners from Pakistan to Morocco and beyond.

Still UAE Radio/Abu Dhabi can be logged by persistent SWLs. Try 13,735 kHz around 0500 UTC. Other frequencies to try include 13,605 kHz or 15,265 kHz at 0600 UTC; 9770 kHz at 1400 UTC; and 11,710 kHz at 1600 UTC.

Reception reports—English is OK—can be sent to UAE Radio, Ministry of Information and Culture, P.O. Box 63, Abu Dhabi, United Arab Emirates. The station sometimes responds with souvenir stickers and postcards.

A better bet for English-speaking listeners, though, is UAE's Dubai Radio from the country's "second" city. The Dubai station not only has an English-language service, but it beams programming to North America from 0330 to 0350 UTC. This time block typically begins with world news, weather (if you want to keep tabs on the thermometer in Dubai), and a feature program.

At this writing, 13,675 kHz was a good frequency, but you can try 12,005 or 15,400 kHz as well. You might also look for the European beam, also in English, at 1600 UTC on 21,605 kHz.

Reports can be sent to Dubai Radio, P.O. Box 1695, Dubai, United Arab Emirates. Again, you can write in English. The station, though, is a bit irregular when it comes to sending a reply.

Weather North

What's the temperature in the Canadian Arctic? Is it snowing in Greenland? It's easy to tune the weather forecasts and actuals that help guide the pilots of commercial jets and military aircraft flying the North Atlantic and Polar routes.

These aviation weather voice transmissions are known as VOLMET and operate on a regular schedule on a number of shortwave frequencies. The Canadian Arctic and North Atlantic weather data is broadcast 24 hours a day from Gander Radio in Newfoundland.

From 20 to 25 minutes past each hour, you can hear weather for Gander, Montreal, Toronto, Ottawa, Mirabel, and Goose Bay, Labrador. The weather data from 25 to 30 minutes after the hour also includes Winnipeg, Edmonton, Calgary, and far north Churchill, which is located on Hudson Bay.

Gander Radio also transmits weather information during the last 10 minutes of each hour, including forecasts or actual observations for St. Johns, Newfoundland; Halifax, Nova Scotia; Sondrestrom, Greenland; and other locations on the North Atlantic track.

Frequencies? Try 3485, 6604, 10,051, or 13,270 kHz, depending on time of day and propagation factors.

If you hear these weather signals, you may want to send a reception report to the Station Manager, Gander IFSS, Transport Canada, P.O. Box 328, Gander, Newfoundland, A1V 1W7, Canada.

Poles Apart

Half a world away, the long-awaited new shortwave transmitter for Argentina's Radio Nacional Arcangel San Gabriel in Antarctica went on the air in February, and early reports have been very good. The frequency is 15,475 kHz.

Several East Coast US SWLs termed the test transmissions as "huge" and predicted this station would no longer be a tough DX catch. I presume regular programming will follow the tests, which were heard during the 2300 to 0100 UTC time period, but 24-hour-a-day programming was promised. We'll see about that.

Broadcasts continue to be all in Spanish, with identification as "Transmite LRA36, Radio Nacional Arcangel San Gabriel...desde la Base Esperanza en el teritorio Antartico Argentino."

Reports, preferably in Spanish, can be sent to the station at Base Esperanza, Tierra del Fuego, Antartida e Islas del Atlantico Sur, 9411, Argentina.

Down The Dial

Looking for something to tune on shortwave. Try these:

ANTIGUA—6195 kHz, the British Broadcasting Corp. programming here is relayed by a transmitter on this West Indian island. At 1115 UTC, make sure to listen for its "Caribbean Magazine" program.

BULGARIA—5850 kHz, Radio Bulgaria, from Sofia, has English programming around 2045 UTC.

COLOMBIA—4955 kHz, Radio Nacional in Bogota has been noted around 0230 UTC with romantic ballads and Spanish-language announcements.

GERMANY—3995 kHz. It's not often you find one of the world's major international broadcasters on a frequency as low as this, but Deutsche Welle's German-language service to Europe can be heard here around 2200 UTC. You can also find it on the more commonly heard channel of 6100 kHz.

MEXICO—4800 kHz, XERTA has mostly Spanish-language programming, of course, but you may hear an English identification and announcements about 1145 UTC.

NORTH KOREA—9335 kHz, Radio Pyongyang signs on in English at 2100 UTC, with tuning signal, ID, news, and military music. You also can try tuning in on the station's parallel frequency, 6575 kHz.

POLAND—7285 kHz, Polish Radio Warsaw can be logged on this frequency around 2040 UTC with regional news in English, identification, and Polish music.

SARAWAK—4895 kHz, Radio TV Malaysia's transmissions on this frequency, heard around 1300 to 1330 UTC are from a transmitter at Kuching, in Sarawak, Malaysia's part of Borneo island.

UZBEKISTAN—5975 kHz, Radio Tashkent transmits in English between 1200 and about 1230 UTC, including news and commentary. It also might be found on 6025 and 9715 kHz at this time.

VIETNAM—9840 kHz, Voice of Vietnam broadcasts in English until 1257 UTC signoff, but the station returns to the air at 1300 UTC with programming in French. Hanoi's SW programs also can be heard on 12,195 kHz at the same time. EN

BY SAM GOLDWASSER
SERVICE EDITOR

Miscellaneous Monitor Problems

THIS TIME WE WILL GO OVER SOME ADDITIONAL MONITOR PROBLEMS THAT DON'T FIT INTO NICE NEAT CLASSIFICATIONS AND A FEW THAT AREN'T REALLY MONITOR PROBLEMS AT ALL!

Lines In The Image

These fall into the category of wavy lines, contour lines, or light and dark bands even in areas of constant brightness. The lines might be almost as fine as the dot pitch on the CRT, or 1 or 2cm or larger and changing across the screen. If the lines are more or less fixed on the screen and stable, then they are not likely to be outside interference or internal power-supply problems. (However, if the patterns are locked to the image, then there could be a problem with the video board.)

One cause of such lines is moiré (interference or beat patterns) between the raster or pixels and the dot structure of the CRT. Ironically, the better the focus on the tube, the worse this is likely to be. If the individual pixels do not cover enough phosphor dots, then the actual color and brightness displayed won't match what the video card is generating; instead, it will depend on the actual location of the pixel relative to the phosphor dots. Trinitrons, which do not have a vertical dot structure, should be immune to interference of this sort from the raster lines (but not from the horizontal pixel structure). Slot mask CRTs (not that common on monitors) also have fewer problems with vertical moiré. See Fig. 1.

You can test for moiré by slowly adjusting the picture size. If it is moiré, you should see the pattern change in location and spatial frequency as slight changes are made to size. Changes to position will move the patterns along with the picture without altering their character and structure significantly (though fine detail will change).

How can you eliminate moiré? If moiré is your problem, then there may be no easy answer. Moiré is a function of geometry; therefore, for a given resolution and size, it will either be a problem or not. One thing you can try is to change size and resolution—ironically, I have a monitor that is nicer in this respect at 1024 × 768 interlaced than at 800 × 600 non-interlaced.

Another thing you can try is to reduce the sharpness of the beam spot and make the picture fuzzier! Yet another approach adds a high-frequency dither to the beam spot position, which might result in a headache! You might find these cures to be worse than the disease. Also, some monitors have a "Moiré Reduction" switch, control, or mode. This may or may not be of help.

I think it is ironic that some people will end up returning otherwise superb monitors because of moiré when in many cases it is an indication of excellent focus—something many people strive for! You can always get rid of it—the converse is not necessarily true!

Isolated Spots On Display

These could be a problem with the video source—bad pixels in the video card's frame buffer or bad spots on a camcorder's CCD, for example. Or, they

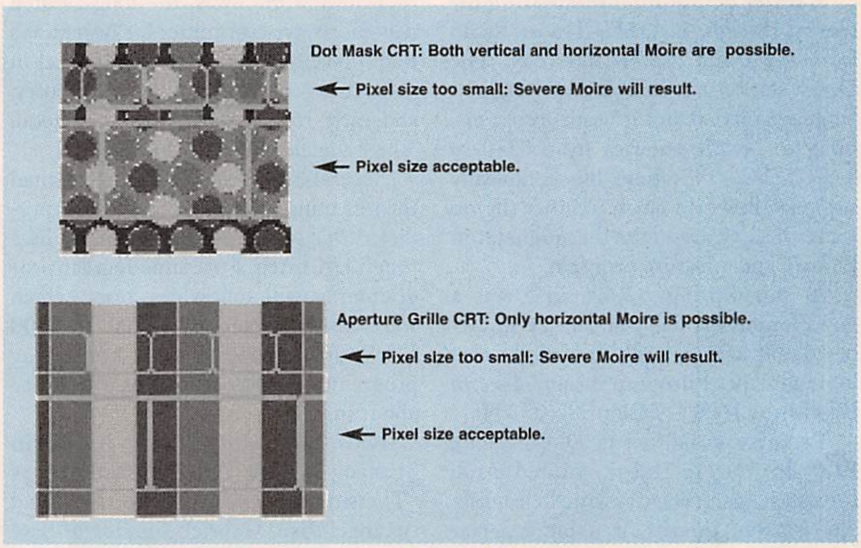


FIG. 1—AS THIS DIAGRAM SHOWS, the size of the pixels determines whether or not a moiré effect will be present. Moiré will affect both traditional dot-mask and aperture grill CRTs, though it will only occur in the horizontal direction for the latter.

could be dirt or dead phosphor areas in the CRT. Except for problems with an on-screen character generator, it is unlikely that the monitor's circuitry would be generating isolated spots.

You can easily distinguish between video problems and CRT problems—missing pixels due to the video source will move on the screen as you change raster position. CRT defects will remain stationary relative to the screen and will generally be much more sharply delineated as well.

Most manufacturers state a specification for the number and size of CRT blemishes that a unit might have before it is considered defective, so you might have to whine a bit to convince the vendor to provide a replacement monitor under warranty.

Power Saving Problems

Modern monitors are usually designed to permit software to control various levels of power-saving ("green") features from blanking the screen to totally shutting down. Problems can occur if the software to control those features is not compatible with the monitor; is not set up correctly; or is attempting to control a monitor that lacks power-saving modes, is defective, or is otherwise incompatible.

A monitor that behaves normally under most conditions but emits a high-pitched whine when the computer attempts to direct it into power-saving mode is probably not understanding the commands or does not have the appropriate power-saving features. It probably behaves about the same as if there is no video signal—which indeed may be the case as far as it is concerned.

Many monitors not receiving proper sync signals are perfectly happy driving everyone in the office insane with that high-pitched whine. Others will blow up eventually.

Recommendation: Don't use power saving until you have the proper software and you know what your monitor supports. Check your user manuals to determine compatibility and setup parameters.

Monitor Shuts Down Or Goes Blank At Certain Scan Rates

It could be the monitor's components have drifted and are now marginal at one or more of your scan rates. However, first check to confirm that your horizontal and vertical timing are indeed as expected.

Some video cards modify horizontal and vertical frequency as part of their software size adjustment in their setup program. For example, with ATI cards, even though the general resolution option in the DOS install program may be 800 × 600 at 75 Hz, adjusting the horizontal size can actually vary the horizontal frequency over a greater than 10% range. A similar variation is possible with the vertical rate.

Buzzing Monitor

The size of the monitor is not a strong indicator of the severity of the problem, but there will be some relationship as the power levels are higher for larger sets. It may be more difficult to quiet down a buzz than a high-pitched whine (see the next section).

- If the problem comes from inside the monitor—make sure it is not your multimedia speakers or sound card picking up interference—it is in the deflection (probably vertical) or power supply. It could be a power supply transformer, deflection yoke, or other magnetic component. Even ferrite beads have been caught buzzing when no one was looking. A dab of hot-melt glue, RTV silicone, or even a strategically wedged toothpick may help. A new part may or may not quiet it down—the replacement could be worse!
- There is a slight possibility that the AC power in your home or office has some harmonic content—the waveform is not sinusoidal. That might be the case if you try to run on the same circuit as an active dimmer or something else with thyristor control. Proximity to heavy industry could also cause this.
- On those rare monitors that have a cooling fan, its bearings may be worn or in need of cleaning and lubrication, or a blade may be hitting something
- Sometimes the buzz or whine is simply a design or manufacturing defect, and the only alternative is a replacement. Unfortunately, you cannot infer the severity of this annoyance from any specifications available to the consumer.

High-Pitched Whine

Sometimes a whine is continuous. In other cases, it comes and goes almost as though there is an intelligence at work attempting to drive you crazy. All the more so since a technician may not even be able to hear what you are complaining about if their hearing is not as sharp at high frequencies as yours. Even high-resolution computer monitors running at high horizontal-scan rates (beyond human hearing) can have these problems due to their switching power supplies as well as subharmonics of the horizontal scan rate exciting mechanical resonances in the magnetic components.

If it is a new monitor and you think the sounds will drive you insane, returning it for a refund or replacement may be the best alternative. However, you might get used to it in time.

While intermittent or poor connections in the deflection or power-supply subsystems can also result in similar sounds, in most cases, this sound, while annoying, does not indicate an impending failure (at least not to the monitor—just to your mental health) or signify anything about the expected reliability of the unit—it is more likely that some part is just vibrating in response to a high-frequency electric current.

There are several parts inside the monitor that can potentially make this noise—the horizontal flyback transformer and to a lesser extent, the deflection yoke and associated geometry-correction coils would be my first candidates. In addition, it could also be transformers or chokes in the switching power supply if this is distinct from the horizontal-deflection circuitry.

You have several options before resorting to a 12-pound hammer:

- As much as you would like to dunk the monitor in sound-deadening insulation, that should be avoided as it will interfere with proper cooling. However, the interior of the computer desk/cabinet can be lined with a non-flammable sound-absorbing material, perhaps acoustic ceiling tiles. Hopefully, not a lot of sound energy is coming from the front of the monitor.
- Move the monitor out of a corner if that is where it is located—the corner will focus sound energy into the room.
- Anything soft like carpeting, drapes, etc. will do a good job of absorbing sound energy of this type. Here is your justification for purchasing those antique Persian rugs you always wanted for your computer room.

If you are desperate and want to check the inside of the monitor:

- Using appropriate safety precautions, you can try prodding the various suspect parts (flyback, deflection yoke or other transformers, ferrite beads, etc.) with an insulated tool such as a dry wooden stick. Listen through a cardboard tube to try localizing the source. If the sounds changes, you know what part to go after.

• Sometimes, tightening some mounting screws or wedging a toothpick between the core and the mounting screws or the coils will help. Coating the offending part with sealer suitable for electronic equipment may quiet it down, but too much might lead to overheating. A dab of hot-melt glue or RTV silicone might help. Even replacement is no guarantee as the new part may be worse.

• A few monitors have internal cooling fans. The whine might be due to worn or dry bearings. If this is the case, the fan must be serviced as it is not likely doing its job and damage due to excessive temperatures could eventually be the result.

Note that the pitch (frequency) of the whine might not even be audible to a technician assigned to address your complaint. The cutoff frequency for our hearing drops as we get older. Someone over 40 (men more so than women) might not be able to hear the whine at all (at least you can look forward to silence in the future!). So, even sending the monitor back for repair may be hopeless if the technician cannot hear what you are complaining about and you are not there to insist they get a second opinion!

Water in Monitor

Water can get inside monitors in a variety of creative ways. For example, it could be placed perfectly under a leak that you did not know was there until the last major storm. Regardless of how it got there, however, the amount of damage that water inside a monitor will do, and hence your course of action, depends on a few factors.

For instance, was the monitor plugged in when the leak started? Any piece of equipment with remote power-on capability has some portions live at all times when plugged in and so there may have been damage due to short circuits etc. Substantial damage could have already been done.

However, if the monitor got wet while unplugged or it has a mechanical (hard) on/off switch, then just give it plenty of time to dry out completely. Assuming all visible water is drained, a week represents a minimum safe time to wait. Don't rush it. There are all kinds of places for water to be trapped and take a long time to evaporate. I have had devices with keypads getting wet that required more than a week but then were fine.

The good news is, generally, some moisture will not do any permanent damage unless the unit was on, in which case you will simply have to troubleshoot it the old-fashioned way—one problem at a time.

Monitor Was Dropped

Needless to say, this is no way to treat a monitor! However, mishaps do happen.

Even if it appears to have survived mostly intact—the CRT didn't implode—you could still have a variety of problems. Immediately unplug the monitor!

If you take it in for service, the estimate you get may make the national debt look like pocket change in comparison. Attempting to repair anything that has been dropped is a very uncertain challenge—and since time is money for a professional, spending an unknown amount of time on a single repair is very risky. There is no harm is getting an estimate (though many shops charge for just agreeing that what you are holding was once a monitor, or was it a fish tank?)

This doesn't mean you should not tackle it yourself. There may be nothing wrong or very minor problems that can easily be remedied. The following are likely possibilities:

1. Cracked circuit boards.
2. Broken circuit components.
3. Broken solder connections particularly to large heavy components on single-sided boards.
4. Broken mounting brackets.
5. Components knocked out of line on the CRT envelope or neck.
6. Internal damage to the CRT. This would most likely be the shadow mask or aperture grille.

Except for 6, all these problems are repairable given enough time (and possibly some cash). Unfortunately, there is no real way to know if the CRT is damaged until the monitor can be powered up with a picture.

Stored Monitors

So the monitor you carefully stuffed in a corner of the garage is now totally dead. You swear it was working perfectly a year ago, and you just have to get that Commodore 64 up and running!

Assuming there was absolutely no action when you turned it on, this has all the classic symptoms of a bad connection. Clean and re-seat all internal connectors, and check for bad solder connections and for other deterioration that may have taken place due to storage conditions.

External Interference

The remaining items deal with monitor problems that are caused by outside sources (though some are also true monitor problems). For your convenience, the various sources of such interference are summarized in Table 1.

Purple Blob—Or Worse

This is a "purity" defect and is most likely caused by magnetic effects. Have you tried demagnetizing the unit? Try powering it off for a half hour, then on. Repeat a couple of times. This should activate the internal degausser—a demagnetizing coil around the CRT—that is a feature of most modern TVs and monitors. If yours lacks one, most television-service shops keep an external degaussing coil on hand.

A CRT could become magnetized in a number of ways. Is there any chance that someone waved a magnet near the tube? Did you place speakers near the unit? On a more drastic and unlikely note, a nuclear explosion generates an EMP that could magnetize the CRT. Nearby lightning strikes may have a similar effect.

If demagnetizing does not help, then it is possible that something shifted on the CRT—there are a variety of little magnets that are stuck on at the time of manufacture to adjust purity. There are also service adjustments, but it is unlikely (though not impossible) that these would have shifted suddenly and caused the present problem.

If the monitor was dropped, then it is even possible that the internal shadow mask of the CRT has become distorted and you now have a seventy-five pound boat anchor. If the discoloration is slight, some carefully placed refrigerator magnets around the periphery of the tube might help.

It is even possible that this is a "feature" that is compliments of the manufacturer. If certain components, like transformers, are of inferior design and/or are located too close to the CRT, they could have an effect on purity. Even if you did not notice the problem when the monitor was first new, the purity might always have been marginal and now a discoloration is visible due to slight changes or movement of components over time.

Jiggling or Wiggling

Note, similar symptoms can be the result of a monitor defect or running the

monitor at a scan rate that is beyond its capabilities. However, magnetic interference from electrical wiring or other equipment is very common and sometimes overlooked when looking for a complex, expensive, and obscure explanation for a misbehaving monitor (or TV).

Interference From Electrical Wiring

If the wiring of normal outlets is done correctly even without a safety ground, the currents should be balanced and you will not experience a problem. However, many circuits, particularly those involving setups like 3-way switches, switched outlets, or wiring in older buildings can have unbalanced currents when active. If your monitors are close enough to the wiring, there can be interference that will take the form of a flickering or pulsating display.

Other than recommending moving the monitors, there is no easy solution. They can be shielded with Mu Metal, but that is expensive. Or you could run all displays at a 60-Hz vertical rate (or 50 Hz depending on where you live). However, this is inconvenient and will never be quite perfect.

If you have flexibility during construction or renovation, there are ways to minimize the chance of unexpected behavior later.

Think of it this way: If the sum of the currents in the cable are zero, there will be no magnetic field to worry about. This will be the case for normal 110 VAC branch circuits.

Some sources for magnetic interference follow:

- Three- (or more) way circuits—lamps or fixtures controlled from more than one location that use a "traveler"—a single energized wire that runs between switches and/or the switches and the load.
- Circuits that do not have their return in the same cable. For example, ceiling fixtures controlled from a wall switch but where the hot comes from another location. Or, a string of baseboard heaters fed from opposite ends.
- Circuits that share a neutral but where one or more of the hot connections are not in the same cable. This is more likely to be found in old construction using knob-and-tube wiring where circuits were just connected in the most convenient way.
- Loops in neutral and ground conductors. The way circuits are supposed to be wired (in the USA at least) is nearly always in a star sort of configuration where the neutral and ground conductors never connect at the ends of the "star." However, due to poor wiring practices, it is quite possible for neutrals to be connected to other neutrals, grounds to be connected to other grounds, or for them to be cross connected at various locations—all without any other symptoms. This can even happen between buildings.

The first step in troubleshooting this type of problem is to confirm that the problem is due to inside wiring—shut off all power to the building (if possible) or at least switch off each circuit in turn to see if the problem disappears (run the monitor from a UPS).

- If the symptoms persist, check for external sources of interference (although there could still be a ground-neutral loop formed by the connection between ground and neutral at the service panel or to other buildings. In this case, the effect would likely be strongest near the service panel.).
- If the symptoms disappear, try to narrow down the circuit or circuits that are responsible by switching each one on individually.

In all cases, running the hot and neutral lines for the circuit in the same cable (or at least in close proximity) will avoid this problem as the total current will sum to zero.

Realistically, you would have to be very unlucky to have a noticeable problem in residential wiring, except near the service panel or high-power appliances.

Power-Line Interference

Power lines (any size from local distribution to large intercontinental transmission lines) nearby can cause noticeable effects to monitors as a result of the magnetic fields surrounding the individual wires—the effects are similar to those caused by unbalanced inside wiring. TVs may not be affected, at least not as much, since they will be running at a vertical rate that is almost the same

TABLE 1—SOURCES OF EXTERNAL INTERFERENCE

Static/DC magnetic fields:
- Unshielded/inadequately-shielded multimedia speakers
- Stereo loudspeakers
- MRI scanner next door

Transient magnetic fields:
- Kid's (or adults) playing with magnets
- Electromagnetic pulse (EMP) from nearby lightning strike
- Changing monitor location or orientation without degaussing

AC magnetic fields (usually at power-line frequency):
- AC or DC wall adapters/transformers
- Fluorescent lamps (magnetic ballast)
- Laser printer and other peripherals
- TV, VCR, DVD, or other A/V equipment
- Additional computer monitor(s) too close
- Large appliances including furnace, A/C, refrigerator, microwave
- Wiring in walls (unbalanced load/shared neutral)
- Wiring in electrical-service panel
- Outside wiring and power distribution equipment

Radio frequency interference:
- High power radio transmitter nearby (broadcast, military, amateur, etc.)

Power-line transmitted interference:
- Lighting on dimmers (incandescent/halogen lamps/fixtures)
- Motor-speed controls (ceiling fans)
- Fluorescent lamps (all types)
- Vacuum cleaners/shop equipment/other brush-type motors
- Equipment using switch-mode power supplies
- Heavy industry down the street

Interference affecting video signal:
- Lack of earth/safety ground (line filter ineffective)
- Ground loop caused by PC and monitor plugged into different circuits
- Cross-connected buildings resulting in ground loop

as the power-line frequency.

The severity of the effects will vary depending on the load distribution on the three (probably) phases, distance, orientation with respect to the monitor, etc. Moving the monitor as far from the offending power lines as possible, experimenting with its orientation, and seeing if you can live with a vertical scan rate equal to the power-line frequency are the only realistic options other than constructing an expensive Mu-Metal box for it.

Interference From Other Equipment

Any type of equipment that uses or generates strong magnetic fields can interfere with a monitor. Other computer monitors or TVs, equipment with power transformers, and electric motors will cause a pulsating or flickering display. Loudspeakers or other equipment with static magnetic fields will cause color purity and/or geometric distortion problems that degaussing will not cure.

The easiest way to confirm that interference is your problem is to move the monitor or suspect equipment to a different location. The only real solution is to separate the monitor and interfering device.

Note that with scan rates that are no longer even near the power-line frequency, a variety of symptoms are possible including shimmering, wiggling, undulating, etc. The rate of the movement will be related to the difference between the monitor scan rate and the frequency of interference.

Wiring Transmitted Interference

The power that comes from the wall outlet is supposed to be a nice sinusoid at 60 Hz (in the U.S.) and, coming out of the power plant, it probably is. However, equipment using electric motors (*e.g.*, vacuum cleaners), fluorescent lamps, lamp dimmers or motor speed controls (shop tools), and other high-power devices, can overlay a noise signal on the power-line frequency, resulting in a variety of effects.

While monitors normally include some line filtering, the noise immunity varies. Therefore, if the waveform is distorted enough, some effects may show up even on a high-quality monitor.

Symptoms might include bars of noise or distortion moving slowly or rapidly up or down the screen or diagonally. This noise may be barely visible as a couple of jiggling scan lines or be broad bars of salt and pepper noise, snow, or distorted video.

The source is probably local—in your house and probably on the same branch circuit—but could also be several miles away.

- One way to determine if the problem is likely to be related to AC power is to switch your vertical scan rate to match the power-line frequency: 60 Hz in the U.S., 50 Hz in most European countries, etc. If the pattern of noise or distortion is now stationary (or at most slowly drifting up or down the screen), the interference is likely power-line related. A single bar would indicate interference at the power-line frequency while a pair of bars would indicate interference at twice the power-line frequency; either of these are possible.
- Try to locate the problem device by turning off any suspect equipment.
- The best solution is to replace or repair the offending device. In the case of a light dimmer, for example, models are available that do a better job of suppressing interference than the typical $3 home-center special. Appliances are supposed to include adequate noise suppression, but that is not always the case.
- Plugging the monitor into another outlet may isolate it from the offending device enough to eliminate or greatly reduce the interference.
- The use of a line filter might help. A surge suppressor is NOT a line filter.
- Similar symptoms could also be produced by a defective power supply in the monitor or other fault. The surest way of eliminating this possibility is to try the monitor at another location.

Shimmering Image Due To Vibrations

If your monitor uses a Trinitron or clone CRT, such an effect might be normal. Even with the 1-3 unsightly stabilizing wires running across the screen, the vertical aperture grille wires in a Trinitron-type CRT can wiggle as a result of mechanical shocks or vibration. Any movement results in momentary changes in color purity, color balance, brightness.

Wrap Up

That's it for now. Next time we will conclude our discussion of monitor troubleshooting and repair. Until then, check out my Web site, www.repairfaq.org. I welcome comments (via e-mail only please at sam@stdavids.picker.com) of all types. EN

Prototype

Twister Early Warning System

Researchers at the Georgia Tech Research Institute (GTRI) are testing the National Severe Storms Laboratory's (NSSL) Next Generation Warning Decision Support System (NG-WDSS) during the 1999 and 2000 tornado seasons. Though the test area is north Georgia, the study results will be applicable throughout the state and could increase warning time by as much as 50 percent. Three systems have been installed: one at the National Weather Service's Peachtree City office and two systems in GTRI laboratories.

"We will be optimizing the system to reflect Georgia's environment," said Gene Greneker, a research scientist who is heading GTRI's recently established Severe Storms Research Center (SSRC). "Tornadoes in Georgia and elsewhere in the South are often short-lived events. They can come and go in 10 minutes, as opposed to an hour in Kansas. As a result, the radar signal processing may need to be set slightly different from those that were developed for the Great Plains states where the NG-WDSS was first developed and tested."

A TORNADO IN HALL COUNTY, GA, in the spring of 1998 caused major damage and claimed several lives.

Optimizing the system will involve researchers in collecting storm data and determining if changing parameters in the NG-WDSS algorithms will make it work better in Georgia. Part of the testing will include collecting data in the aftermath of tornadoes to determine how much advance warning the NG-WDSS issued.

NG-WDSS provides a set of tools that help forecasters make more efficient, effective, and timely decisions on warning the public of tornadoes, severe thunderstorms, and flash floods. The system includes advanced image processing, artificial intelligence, neural networks, and other algorithms that use Doppler radar data. The data is integrated with other weather sensor data to guide forecasters. Another important part of the system is how it displays and presents information.

The NSSL has successfully tested NG-WDSS in various parts of the country since 1996, when it operated as an advanced system at Peachtree City during the Olympics. Because of the expense of deploying the NG-WDSS, it will not be fully implemented across the country for another five to seven years, Greneker said.

But in Georgia, funding from the Georgia Emergency Management Agency (GEMA), the Federal Emergency Management Agency (FEMA), and the Georgia General Assembly allowed the SSRC to contract with NSSL to deploy the NG-WDSS that was already installed in Peachtree City and at Georgia Tech. Bell South Business Systems is also providing funds, which will pay for high-speed transmission lines.

An initial year of funding for SSRC, a three-year project, followed recommendations made by the Task Force on Warning and Communications after severe storms claimed 23 lives in Georgia in 1998. Continued support for the project is expected.

Saving Lives

Forecasters and emergency management officials believe that better warning systems, such as the NG-WDSS, could lower those death tolls. In addition to improving warning time, NG-WDSS should result in fewer false alarms.

When GEMA chose Georgia Tech as the site for the Research Center, it outlined its mission. The SSRC would

serve as a quick-response information resource for weather and emergency management agencies, develop a plan for expanding Georgia's severe storm spotter network with help from two-way radio-equipped public safety personnel, and provide real-time information regarding tornado development or ground track coordinates to the National Weather Service. In addition, it would determine whether tornadoes occur in certain areas of the state more often than others. If so, forecasting resource improvements would concentrate on these "tornado alleys."

The center will also work with agencies to educate Georgians about floods and hurricanes and to develop methods to quickly transmit flood and hurricane effects data to county-level emergency managers. Other objectives are to provide information on and evaluate advanced communications techniques for GEMA and to develop a library of the latest knowledge on severe storms, including a data base of severe storm dynamics. PT

Real-Time Asbestos Alert

As most readers know, asbestos is a naturally occurring fibrous ore used in construction materials such as slate, fireproof materials, and friction materials such as brake linings. Inert and undisturbed it is harmless; but when particles become airborne and are subsequently breathed in, it can cause diseases such as asbestosis, lung cancer, and mesothelioma. Consequently, asbestos use is strictly controlled and regulated in Japan, the U.S., and in many other countries.

THIS PORTABLE, REAL-TIME ASBESTOS-MEASURING DEVICE was developed by Toyo University's Department of Engineering and the Escom Corporation. It could also be adapted to measure other types of airborne particles.

Asbestos, however, has highly useful qualities such as great tensile strength, fire-resistance, and high heat resistance. Because of that, large amounts of the material will in all probability continue to be used in the future. What's more, uncounted millions of tons of the material are already in-place worldwide in buildings ranging from homes to towering skyscrapers.

The question then arises: How do you adequately protect workers in factories where asbestos-based products are produced, workers on construction sites where asbestos is either being removed or installed, and innocent bystanders and home owners who are breathing in asbestos without even being aware of its presence?

One way is to develop practical asbestos-particle concentration monitors. Currently, the PCM (phase-contrast microscope) method is the main method of measuring the concentration of asbestos particles in the atmosphere. As air passes through a filter, airborne particles collect on it. The particles are then counted under a phase-contrast microscope. The downside of this method is that discrepancies in the results can occur due to human error in the counting stage and it takes several days to process the tests. Thus, a more accurate and instantaneous method of measuring asbestos levels has long been desirable.

A Real-Time Alert

A method of detecting atmospheric particles (aerosols) in real time does exist. A sample of air is collected and passed through a tube, where it is irradiated with laser light. Airborne particles passing through the tube are detected by examining how the light is scattered. This method, however, cannot distinguish between asbestos particles and other air particles.

However, it does form the basis of a real-time asbestos-detection device developed jointly by Japan's Toyo University Engineering Department and the Escom Corporation. That device takes advantage of the fact that scattered polarized light with a scattering angle of 170 degrees (almost back scattering) appears very different when scattered by cylindrical particles like those of asbestos. In short, the component of polarized light that is parallel to the long axis of cylindrical particles is more intense than polarized light rays that are perpendicular to the long axis. This tendency is not seen in polarized light scattered by round particles. This difference makes it possible to distinguish between asbestos particles and other airborne particles.

In use, the device draws a sample of air containing floating particles into a tube. The sample is exposed to a strong electric field to align the particles in the same direction. As particles pass through a laser beam, the two perpendicular components of polarized light pulses scattered by the particles are measured. This measurement makes it possible to identify and count asbestos particles. In tests, the concentration of airborne asbestos particles measured in real time by this device was very close to the measurement provided by the conventional PCM method.

A portable model of the measuring equipment for on-site monitoring of asbestos pollution has also been developed. That portable model consists of a small (36 by 48 by 16 centimeter) box that contains a laser, particle alignment device, polarizing beam splitter, two-channel photomultiplier tube, and pump. The asbestos-particle concentration is displayed on a liquid-crystal display screen in real time via electronic circuitry containing a microcomputer. Measurement data is also printed out on hard copy.

Note that since particles with different optical qualities and different shapes and sizes each scatter light in their own characteristic manner, this method can be used to detect other particulates besides asbestos by changing parameters such as the wavelength of the laser, the scatter angle measured, and the method of distinguishing between different kinds of particles. This system could be used, for example, to monitor air pollutants that pose health risks such as diesel particulate emissions (DPE), ultra-fine particulates (PM 2.5), household mites, and various airborne pollen grains. As one application of photoelectronics technology, this kind of research could open up many useful fields that will help protect the environment and improve society.—**Hiromoto Norihisa (Courtesy Look Japan, February 1999)** PT

Waste Not, Want Not

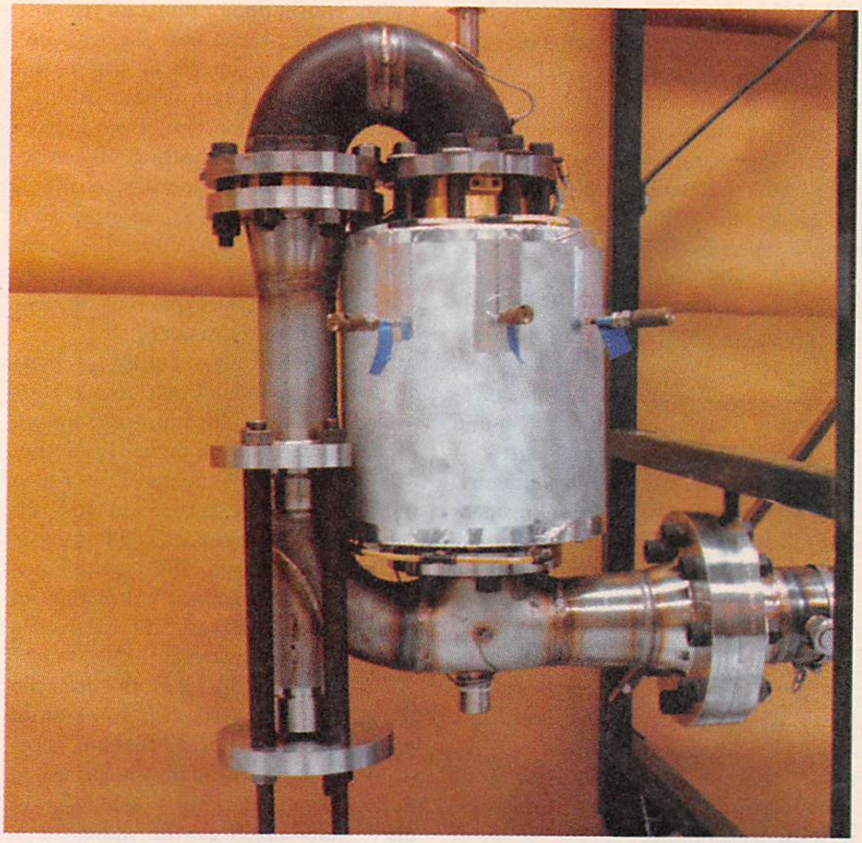
In a step toward finding alternatives to conventional engines, scientists at the DOE's Los Alamos National Laboratory have developed a remarkably simple, energy-efficient engine with no moving parts. Pollution concerns, global warming, and shrinking fossil fuel reserves have focused world attention on how engines generate electrical and mechanical power. Engines with higher efficiency help conserve fossil fuels and reduce emissions by consuming less fuel to generate an equivalent amount of power. Today most engines are internal combustion or turbines.

Los Alamos researchers Scott Backhaus and Greg Swift have developed a thermoacoustic Stirling heat engine consisting of a long, baseball-bat shaped resonator with an oval "handle" on the lower end. Filled with compressed helium and constructed of inexpensive steel pipe, the device is highly reliable and decidedly low-tech.

With the application of heat to the compressed helium contained within the system through a heat exchanger located on the "handle," the engine creates acoustic energy in the form of sound waves. This intense acoustic energy can be used directly in acoustically powered refrigerators or to generate electricity. The power production process is environmentally friendly and up to 30 percent efficient while typical internal combustion engines are 25 to 40 percent efficient.

According to Backhaus, "The efficiency of conventional engines is limited both by the laws of thermodynamics and practical concerns over the cost of building and operating complex engines. Typically, the highest efficiencies can only be obtained from expensive engines like the large turbines used by electrical utilities. Our engine is neither mechanically complex nor expensive."

The idea behind the engine comes, in part, from the Stirling cycle where a confined volume of gas expands at high pressure and contracts at low pressure, thereby doing work on the surrounding environment. The expansion and contraction of the gas is driven by the absorption and rejection of heat at the engine's hot and cold heat exchangers.



FILLED WITH COMPRESSED HELIUM and constructed of inexpensive steel pipe, the thermoacoustic Stirling heat engine is highly reliable and decidedly low-tech, contains no moving parts, requires little or no maintenance, and can be manufactured inexpensively.

The discovery of this principle by Robert Stirling in 19th century Scotland laid the groundwork for the conventional Stirling engine in which a fixed amount of helium is compressed in a cool chamber and then transferred to a chamber heated by an external burner. As the gas expands, it drives a piston that delivers energy. As it cools, it returns to the cool chamber and the cycle begins again.

According to Swift, there are many possible applications for his engine. "For instance, small low-cost engines like this could be used in homes for co-generation. That is, they could be used to generate electricity while at the same time producing heat to warm the home or for hot-water heating." Because the thermoacoustic Stirling heat engine contains no moving parts and is constructed of common materials, it requires little or no maintenance and can be manufactured inexpensively.

Backhaus and Swift are working on ways to use solar power to heat the engine and, in turn, generate electricity. There may even be uses for the exhaust heat from internal combustion engines to power a car's air- conditioning.

The Los Alamos group is also collaborating with Cryenco of Denver on a combustion-driven thermoacoustic refrigerator that liquefies natural gas. "Associated" natural gas that is currently flared (burned off) at remote oil wells worldwide creates pollution and greenhouse gases without producing any useful energy. Liquefying the natural gas makes it economically feasible to transport the gas to locations with existing pipelines. PT

Talking to Computers

Sensory, Inc. and Sarnoff Corp. are working together to bring voice control of cell phones, home appliances, automobiles, and other consumer products into the mainstream by improving speech recognition accuracy in noisy environments. Sensory is a

global leader in consumer product speech recognition technologies, and Sarnoff is a renowned research center that creates and commercializes electronic, information, and biomedical technology. Sarnoff's new VoiceThru noise-reduction technology lessens or eliminates noise that would otherwise reduce speech-recognition accuracy. Sensory will license the use of VoiceThru and incorporate it into their own interactive speech ICs and software products.

"We reviewed a variety of noise-reduction techniques and found Sarnoff's VoiceThru offered the greatest improvement in noisy environments," said Todd Mozer, Sensory's President and CEO. "In our initial tests, Sensory found over a 40% error reduction on voice recognition in noisy environments," he added.

By the time this is published, Sensory's first speech recognition ICs (the RSC-364 and RSC-264T) utilizing VoiceThru will be released and the noise-reduction technology will be available in their DSP and 16-bit software-based solutions.

Speech recognition is one of the fastest growing segments of the technology industry, making inroads into everything from consumer electronics to computer applications. To be universally accepted, however, speech recognition must perform in the most demanding high-noise environments.

"VoiceThru is a novel family of speech-enhancement algorithms, with solutions spanning low-complexity spectral-based methods to multiple microphone/statistical beamforming techniques," said Bill Porter, VoiceThru General Manager. "We are delighted to work with Sensory in adapting our VoiceThru technology for use with their low-cost speech-recognition engine." PT

Buried Communications

A new type of thin-film transistor developed at the University of Illinois at Urbana could improve the resolution of flat-panel, liquid-crystal displays used for tomorrow's HDTVs and laptop computers. The transistor contains a novel "buried channel" that allows electrons to move faster, permitting much higher switching speeds.

"In conventional thin-film transistors, electrons travel near the semiconductor-insulator interface, where the silicon is strained and of poor quality," said John R. Abelson, professor of materials science and engineering. "By creating a buried conducting channel, recessed about 50 angstroms away from the interface, we can increase the speed of the electrons and significantly enhance the performance of devices built with these transistors."

Flat-panel displays consist of hundreds of thousands of pixels, each controlled by a thin-film transistor. Future applications requiring higher resolution will be limited by the speed at which transistors can be turned on and off. "Higher resolution means adding more pixels," Abelson said. "But as the number of pixels rises, there is less time to address each one and still produce a complete image at standard video rates."

To improve this performance, the buried channel is placed in a region of higher quality material, enabling electrons to move through the device at nearly twice the normal speed. Thus, many more pixels can be addressed in the same amount of time.

Abelson and graduate student Cory Weber fabricated the buried channel thin-film transistors by using a technique called magnetron sputtering. This technique provides precise control over layer composition and electronic properties and allows films to be deposited at much lower temperatures than currently possible. PT

Lincoln Log Lattice

By interlocking tiny slivers of silicon into a lattice that, under a microscope, appears to be formed by Lincoln logs, Sandia scientists believe they have solved a major technical problem. The question is how to bend light easily and cheaply without leaking it, no matter how many twists or turns are needed for optical communications or (potentially) optical computers.

The lattice, dubbed a photonic crystal, now works in the infrared range (approximately 10-micron wavelengths). This technique can be used to enhance or better transmit infrared images. Sandia researchers Shawn Lin and Jim Fleming are preparing a 1.5-micron crystal—the region in which almost all optically transmitted information is passed.

This improvement bends far more light in far less space at considerably less cost than current commercial methods. The lattice will make possible tinier, cheaper, more effective waveguides that will either combine or separate optical frequencies at the beginning or end of information transmissions. It also will find wide application in data transmissions and in more compact and efficient sensors. PT

Medical Diagnosis by Sound

Los Alamos National Laboratory recently awarded license rights to Interferometrics Inc. to develop a suite of noninvasive medical diagnostic tools based on the laboratory's swept-frequency acoustic interferometry technology (SFAI).

SFAI is a technique developed by a team of scientists and engineers from Los Alamos led by Dipen Sinha that uses high-frequency sound to characterize liquids, gases, mixtures, emulsions, and other fluids inside sealed containers. The sound sets up standing waves inside the object being studied. By varying the sound wave across a range of frequencies, it is possible to obtain a series of standing waves, producing spectrums that contain physical information about the object. The information includes sound speed and attenuation, fluid density and viscosity, and acoustic nonlinearity.

The SFAI technique can noninvasively detect chemical warfare agents inside munitions. Other potential applications include use in basis research; biomedical and environmental sensors; the chemical, food and beverage, pharmaceutical, and petroleum industries; and use by customs agents for drug interdiction. Interferometrics officials said they plan to modify the technology to develop an intraocular (eye) pressure monitor and many other noninvasive pressure tools for physicians to perform diagnostic tests in the office, saving time and money. PT

BY MARC ELLIS

The Model 70 Comes to Life

LAST MONTH, WE CONCLUDED A VISUAL INSPECTION OF THE PHILCO MODEL 70 CATHEDRAL THAT HAS BEEN UNDER RESTORATION FOR THE PAST FEW ISSUES. A COUPLE OF AREAS WHERE THE ORIGINAL CIRCUIT HAD BEEN MODIFIED WERE discovered. All six of the set's bakelite block capacitors and both of the metal-can capacitors were removed for rebuilding. Finally, all blocks and cans were "unpotted" and their original components removed. A set of replacement caps (and in one case a resistor), previously mail-ordered, had arrived in time for this month's session and were waiting to be installed in the vacated enclosures.

Rebuilding and Reinstallation

I must say that, even with the additional complication of having to remove, research and unpot the contents of the Bakelite blocks and cans, this was probably the easiest recapping job I've ever done. Removal of the blocks was a snap compared to removal of the individual caps in a conventionally-built radio. The terminal lugs atop the blocks are raised well above the other wiring in the set and are easily accessible. Anyone who has tried to desolder a component from a tube-socket lug buried in a tangle of leads knows the frustration of trying to complete the operation without scorching surrounding wiring or parts.

Not only that, but each lug had only a few leads attached to it compared with the four or six per lug one often encounters when removing individual caps. As an added bonus, taking out the bakelite blocks left at least one end of most resistors in the set disconnected, greatly facilitating the checking of these parts for out-of-spec values.

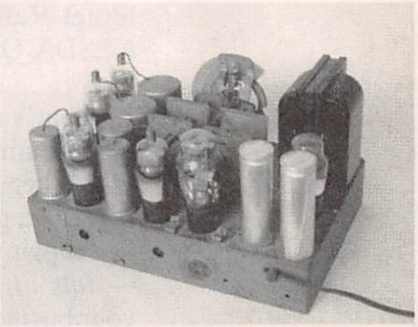
Thanks to their diminutive size, the modern caps fit easily into the bakelite enclosures. Slipping them in with their wires passing through the terminal eyelets, wrapping the leads around the external terminals, and soldering them in place was an easy and pleasant job. Even the large (0.5-µF) cap required for one of the metal-can enclosures made it inside the relatively skinny space without causing hardly any bulge. Reinstallation of the rebuilt blocks on the chassis was also quite a simple matter thanks to the careful notes I'd forced myself to make on connections and lead dress.

Untangling the Wiring

In a previous column, I'd mentioned a few spots where the original circuit had been rewired or compromised. One problem was that each of the set's two 240,000-ohm resistors had roughly doubled in value. I replaced them with modern composition resistors of the proper value. This may have been a problem even when the set was current. One of the service notes in the *Rider Manual* listing for the radio indicated that those particular resistors had been changed from the old fashioned metal end-cap version (which were originally in my set) to what was called the "Continental Carbon type. This is the resistor without the metal ends."

Another problem area was the volume control pot—a 2-section unit controlling (a) cathode bias of the RF and IF amplifiers and (b) RF input to the antenna coil. The antenna connection had been removed from the wiper of the RF section of the pot and connected directly to the antenna coil. I wondered if the pot had been bypassed because it had opened up.

An ohmmeter check suggested otherwise, though the resistance changed quite erratically as the pot was run through its range. Luckily, it was a simple matter to push the metal cover off the back of the pot—providing access to both sections. A puff or two of contact cleaner sprayed inside, followed by a vigorous working of the control, smoothed out the action quite nicely. Satisfied that the pot was OK, I returned the antenna connections to their normal configuration.



TO MAINTAIN PROPER APPEARANCE, the recapping project included the installation of two dud replacement screw-mount electrolytics (lower-right corner of chassis) in the mounting holes for the original Philco units.

The other questionable area involved the filter caps. At some time in the past, the two individual 6-µF, 450-volt units had been replaced with a multi-section can (of war-surplus origin, judging from its markings). The wiring had looked quite suspicious at first glance, including

as it did a 750-ohm power resistor that had no place in the original circuit. The specs etched on the can looked suspicious, too, though it was hard to read them while the unit was still installed on the chassis.

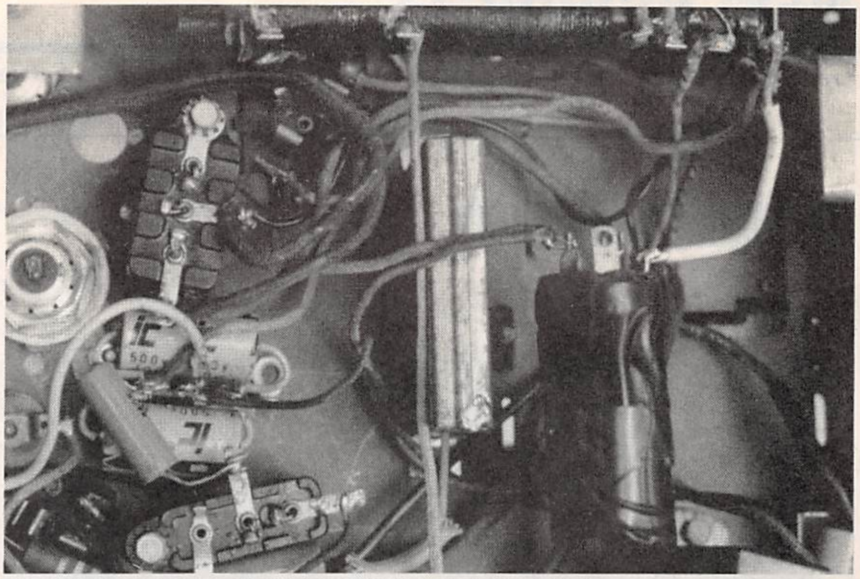
I didn't want to disconnect this cap until all of the bakelite block units were reconnected. I confuse easily and there were already entirely too many free leads floating around on the chassis! However, now I was able to look into the problem, so I quickly removed the wiring from the capacitor—noting the point where each lead had been connected.

With the cap removed from the set, I made an interesting observation. Though "+" terminals had been provided for three separate sections, the can contained only a single 10-µF at 450-volt unit. The codes for the two unused terminals were marked "0 µF—0 volts!" Yet the capacitor had been wired as if not one but two of the terminals were in use. The mysterious power resistor was connected between what was supposed to have been "B+" to the third dummy terminal. God knows how the radio sounded, or performed, with this strange lash-up.

My parts purchase for this set included two individual 10-µF at 500-volt tubular electrolytics. These tiny units are hardly larger than, say, the 0.01-µF bypass capacitors of 50's or 60's vintage. I mounted them on a small 3-terminal strip to facilitate wiring and found a spot under the chassis where I could tuck them in between other components using an existing mounting hole. Then I completed the wiring according to the Rider schematic.

For appearance's sake, I was interested in installing a pair of dud screw-mount can-type electrolytics above the chassis in the original mounting holes. My own junkbox was no help, but my friend Chuck Schwark, proprietor of the well-known "Philco Repair Bench" Web site (check it out at members.aol.com/caschwark/index.htm) came up with a couple of NOS (new old stock) screw-mount 10-µF Aerovox cans of the type that would have been used as replacements for the original Philco units.

They had dried out to the point where they couldn't be reformed, but were visually great! After I removed the rather garish Aerovox labels (the ossified glue made this one of the more difficult jobs, so far, in the restoration), the cans looked quite convincing, and almost like



THE TEMPORARY 10-µF ELECTROLYTIC CAN CAPACITOR can be seen wrapped in electrical tape at right. The two new electrolytics (one of which arrived defective) are at left, center. Above and below these caps are two of the rebuilt bakelite block units. The large nut that is just above left center retains one of the dud screw-base electrolytics.

the originals.

Incidentally, Chuck also responded to the question I posed last time about the possible toxicity of the black waxy potting compound used in the Bakelite block caps. It's not dangerous at all, he says—just wax!

The Smoke Test

At this point, I couldn't see any reason why the set shouldn't be powered for its initial test. I facetiously call this stage "the smoke test," although, since my policy is to completely recap any set before initial start-up, the test is usually quite uneventful. Not so this time, however!

After flipping on the power switch, the voltmeter I had connected to monitor B+ quickly climbed to about 30 volts and stopped. At the same time, the surface of my workbench began to reflect a series of erratic blue flashes worthy of a pyrotechnics display! I hurriedly cut the power after tracing the source of the fireworks to the 80 rectifier tube.

I really couldn't believe there was a short in the wiring, and an ohmmeter connected across B+ read over 7K. Taking a look at the 80, I saw that its filament support structure had failed and pieces of the metal were floating around inside and resting on the plates of the tube. Most of the rectifier failures I've observed were signalled by a red glow coming from the overheated plates, not complete meltdown! So I began to think that maybe this problem was nothing more than a tube that had been seriously shaken up and damaged when the set was shipped to me.

After testing all tubes to make sure there were no other such problems (something I probably should have done earlier in the game), I decided to risk another 80. This time the ominous warning glow coming from its plates allowed me to shut off the power before the tube was destroyed.

I hoped I hadn't miswired one of the Bakelite block units or installed a faulty cap in one of them. That might have been a tough problem to trace! However, by isolating the power supply wiring from the set proper, I was able to determine that the fault was in the supply and not in the other circuits. It turned out that one of the new 10-µF electrolytics was leaky!!! Doesn't seem fair, does it?

Eureka!

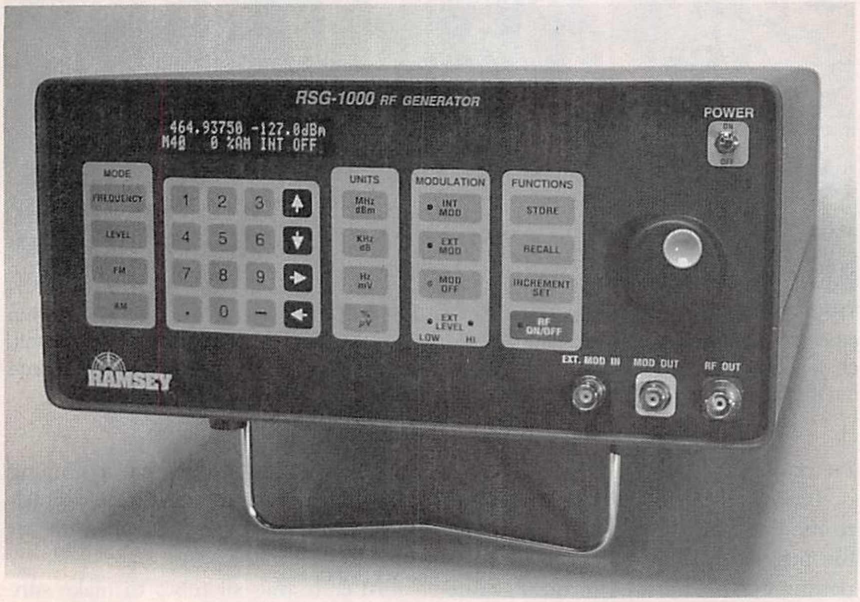
Searching through my junk box, I found an old 10-µF, 450-volt unit in a fairly small can. Putting it through a "reforming" process (done by slowly upping the voltage while keeping the current under a milliampere or so, using the leakage test function of my cap tester), I finally deemed it usable at full working voltage. Wiring it into the set temporarily in place of the bad unit, I was now rewarded by seeing plate voltage rise to 350 or so and hearing an

(Continued on page 95)

NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

RF Signal Generator



CIRCLE 20 ON FREE INFORMATION CARD

CAPABLE OF GENERATING FREquencies from 100 kHz to 1 GHz, the full-featured RSG-1000 DDS-based synthesized RF signal generator is geared toward R&D labs, schools, and production test and repair facilities. It features 10-Hz continuous tuning, a standard frequency-reference stability of 1.0 PPM, and both calibrated FM and AM modulation The standard output level of the signal generator is 0 dBm.

The RSG-1000 includes a bright, super-readable, two-line, vacuum fluorescent display of all functions that can be read from anywhere on the bench. Data is entered via the keyboard or the analog-style spinner knob. This handy "smart knob" is easy to use to enter or change parameters in any field. All functions can be continuously varied without the need to ever touch a "shifted" or secondary function key.

The unit, which measures 12 × 6 × 12 inches and weighs 11 lb., provides a solid-state GaAs calibrated attenuator down to -130 dBm. Reverse power protection is also included. An optional RS-232 interface provides polled readout and downloading of all front-panel setups. Other options include external reference input, 0.1 PPM high-stability timetable, and 0.1db amplitude level flatness.

The RSG-1000 RF signal generator has a suggested retail price of $1495.

RAMSEY ELECTRONICS, INC.
793 Canning Parkway
Victor, NY 14564
Tel: 716-924-4560
Fax: 716-924-4555
Web: www.ramseyelectronics.com

Li-Ion Camcorder Battery

INTRODUCED AS THE WORLD'S first 4-in-1 Li-Ion (lithium ion) multibrand rechargeable battery, the 4-in-1 can be used as a direct replacement for four of the most popular camcorder batteries: Sony NPF 550 (InfoLithium), Panasonic VW-VBD1E, JVC BN-V812, and Hitachi VMBL13, and many others as well. The battery is also fully compatible with more than 85 different camcorder models.

According to the manufacturer, the 4-in-1 battery offers performance, charge retention, and longevity that's equal to or exceeds OEM batteries, and provides high power and long life. Its

CIRCLE 21 ON FREE INFORMATION CARD

"NoMEM" (no battery memory) feature eliminates the need to discharge the camcorder battery before recharging. There are three different battery capacities: 1550 mAh (Model LIM550), 3100 mAh (Model LIM750), and 4650 mAh (Model LIM950).

The 4-in-1 Li-Ion battery models, LIM550, LIM750, and LIM9503, have suggested retail prices of $59.95, $99.95, and $139.95, respectively.

LENMAR ENTERPRISES, INC.
31328 Via Colinas, #102
Westlake Village, CA 91362
Tel: 800-424-2703 or 818-879-2700
Fax: 800-336-2703 or 818-879-2703
Web: www.lenmar.com

All-Mode Transceiver

THE IC-706MKIIG ALL-MODE transceiver (SSB, CW, RTTY, AM, and FM) provides coverage of HF, 6 meters, and 2 meters—all in one box. It is the latest in the '706 series radios from Icom, and it offers more power on the 2-meter band plus added 440-MHz coverage. Features include an automatic repeater function; CTCSS encode/decode; DSP capabilities, such as noise reduction and auto-notch functions; 107 memory channels with alphanumeric capability; and illuminated keys and switches.

The compact transceiver, 6.6 by 2.3 by 7.9, is housed in a one-piece aluminum, die-cast chassis, which contains a large cooling fan. It's a mobile-sized

CIRCLE 22 ON FREE INFORMATION CARD

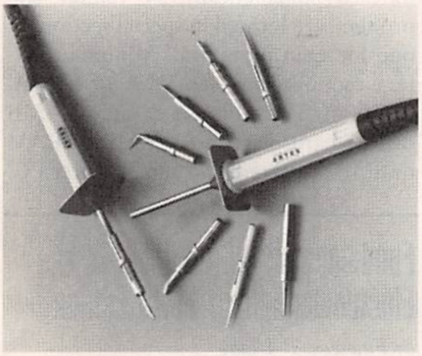
rig with the flexibility to operate as a base-station so it can work in your shack, in your vehicle, or during DX'peditions. Add the optional 11- or 16-foot separation cable and the main unit can be stored in your car's trunk, under the seat, or under the dash, with the controls at your fingertips.

The IC-706MKIIG all-mode transceiver has a suggested retail price of $1680.

ICOM AMERICA, INC.
2380 116th Avenue, NE
Bellevue, WA 98004
Tel: 425-454-8155
Web: www.icomamerica.com

Miniature Soldering Iron

IDEALLY SUITED FOR ELECTRONIC assembly work, the Antex Model G/3U Precision Miniature Soldering Iron is built for comfort and efficiency. Located directly under the tip, the heating element of the miniature solder iron is designed for optimum thermal efficiency. Constructed with a plastic handle that remains cool while soldering is being done and a metal heat shield, this positively grounded industrial-grade soldering iron recovers instantly after soldering each joint.



CIRCLE 23 ON FREE INFORMATION CARD

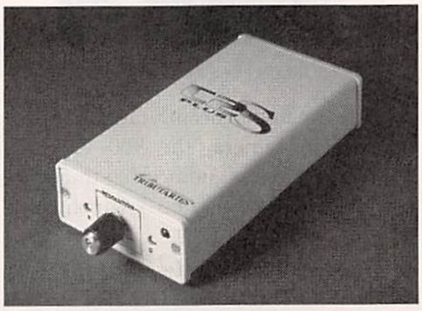
The lightweight miniature (6½ inches long by ¾ inches wide and weighing under ¾ ounce) 18-watt soldering iron provides power and performance comparable to a conventional 30-watt iron and reaches 750°F in only 45 seconds. Over 40 different shapes and sizes of slide-on tips, including spades, chisels, pyramids, and needles are available for virtually all soldering tasks.

The Antex Model G/3U Precision Miniature Soldering Iron, which includes a standard tip, has a list price of $25.32, and tips are priced from $2 each, depending upon shape, size, material, and quantity.

M.M. NEWMAN CORP.
24 Tioga Way
P.O. Box 615
Marblehead, MA 01945
Tel: 781-631-7100
Fax: 781-631-8887
Web: www.mmnewman.com

S-Video Convertor

THE C2S PLUS POWERED COMposite to S-Video Convertor converts composite video to S-video. It uses an active circuit and state-of-the-art comb filters to separate the Y (luminance) and C (chroma) information, which defines the Y/C S-video signal. After comb filtration, both signals are passed through special 6-dB amplifiers providing maximum dynamic range and stable load impedance at 75 ohms. The unit's specially designed circuitry ensures high resolution and superior signal-to-noise and black-and-white ratios.



CIRCLE 24 ON FREE INFORMATION CARD

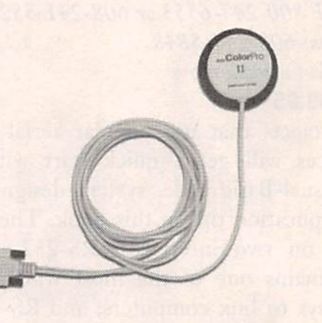
A conventional front-panel control knob sets picture resolution. Dedicated, screwdriver-adjustable, front-panel controls calibrate both the luminance and the chroma channel, to achieve an even, consistent video performance. Located on the rear panel is a gold-plated composite-video "in" and a heavy-duty gold-plated "S" connector.

The C2S Plus Powered Composite to S-Video Convertor has a suggested retail price of $300.

TRIBUTARIES
1307 E. Landstreet Road
Orlando, FL 32824-7926
Tel: 800-521-1596
Web: www.tributariescable.com

Color Analyzer

TECHNICIANS GET FAST, LABoratory-accurate chromatic and luminance measurements on all CRTs with the CP288 PC-based AutoColor Pro II Color Analyzer. The easy-to-use Windows GUI provides four options for displaying the measured data: a CIE chromaticity diagram, large CIE coordinates, RGB levels, and a control window. Automatically, the color analyzer reads and displays the refresh rate of the display under test. All readings are presented in industry-standard measurement units and display modes.



CIRCLE 25 ON FREE INFORMATION CARD

Since the CP288 has the specs necessary to do a complete white-balance alignment, technicians can be sure to match display manufacturer's specifications. The reference data can be entered, stored, and programmed directly by the user. Tracking data is easy with the CP288. Straight from the measurement screen, the analysis can be printed, complete with the manufacturer's name, model number, serial number, and measured data.

The CP288 AutoColor Pro II Color Analyzer has a list price of $1495.

SENCORE INC.
3200 Sencore Drive
Sioux Falls, SD 57107
Tel: 800-SENCORE or 605-339-0100
Fax: 605-339-0317
Web: www.sencore.com

EN

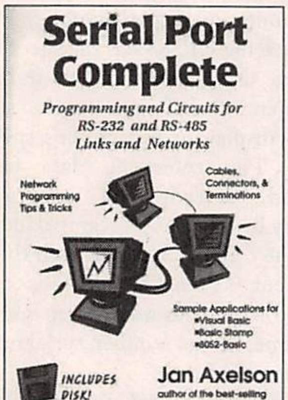
NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Serial Port Complete: Programming and Circuits for RS-232 and RS-485 Links and Networks

by Jan Axelson
Lakeview Research
2209 Winnebago Street
Madison, WI 53704
Tel: 800-247-6553 or 608-241-5824
Fax: 608-241-5848
Web: www.lvr.com
$39.95

Projects that use popular serial interfaces will get a quick start with the Visual-Basic code, system designs, and application tips in this book. The focus is on two interfaces: RS-232, which remains one of the most widely used ways to link computers; and RS-485, a simple, inexpensive solution for networks and very long links. The included disk contains all the code presented in the book.



CIRCLE 338 ON FREE INFORMATION CARD

The topics include options for linking two or more computers, serial communications with Visual Basic's MSComm, and data formats and protocols—with special attention to network programming issues. Explanations of the theory behind the designs make it easy to adapt the examples for specific projects. Platforms covered include PCs, as well as links between PCs and the Basic Stamp and 8052 microcontrollers.

Microvideo Catalog 40

from Supercircuits
One Supercircuits Plaza
Leander, TX 78641
Tel: 800-335-9777 or 512-260-0333
Fax: 512-260-0444
Web: www.supercircuits.com
Free

Featuring the world's smallest video cameras and more, this catalog is a complete resource for professionals and hobbyists who are interested in custom-video solutions, law enforcement, security and surveillance, undercover video, loss prevention, and wireless video. New products include the PC-57XP color pinhole microvideocam, the PC-56XS microvideo camera, the 900-T2 900-MHz FM wireless audio/video transmitter, and the MON-4TFT3 4-inch color TFT monitor.

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In addition, the 62-page catalog offers an array of wireless microvideo products, multi-camera systems, quad processors, monitors, VCRs and camera lenses and accessories, and phone line and internet video products. Each product is accompanied by a full-color photo, specs, and price information. Tech notes are also provided.

1998 ARRL Periodicals CD-ROM

American Radio Relay League
225 Main Street
Newington, CT 06111-1494
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Fax: 860-594-0303
Web: www.arrl.org
$19.95

All the 1998 issues of ARRL's membership journal, *QST*; their technical magazine, *QEX*; and their bimonthly *national Contest Journal* (*NCJ*) are contained in this CD-ROM. In addition to the complete text and illustrations for all articles,

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it includes a powerful search engine, tools to create bookmarks, a Web browser, Windows printing capability, and Clipboard support.

A total of nearly 1000 ad images, indexed alphabetically by vendor and product, are located in special sections—one for each periodical. Minimum system requirements are VGA or SVGA, Microsoft Windows 3.x or newer, 4MB of free hard-drive space, 4MB of RAM or 8MB preferred, and 386 or better PC.

Fundamentals of Applied Electromagnetics: 1999 Edition

by Fawwaz T. Ulaby
Prentice-Hall
One Lake Street
Upper Saddle River, NJ 07458
Tel: 800-643-5506
Web: www.prenhall.com
$92

Appropriate for an electromagnetics course, this text leads students from familiar circuits material into more advanced topics and applications. The book begins with a discussion of transmission lines, a natural bridge between electric circuits and new electromagnetics materials. Earlier and stronger emphasis on dynamics in this edition permits coverage of practical applications in communication systems, radar,

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optics, and computers.

An included CD-ROM comes complete with sample solutions for 45 problems selected from end-of-chapter problems in the text and all the figures from the text. The CD-ROM enables students to generate a high-quality print of a Smith chart for use with Chapter 2.

Making Your Own Printed Circuit Boards, 2nd Edition

from JV Enterprises
P.O. Box 370
Hubbardston, MA 01452
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Web: http://home.att.net/~jventerprises
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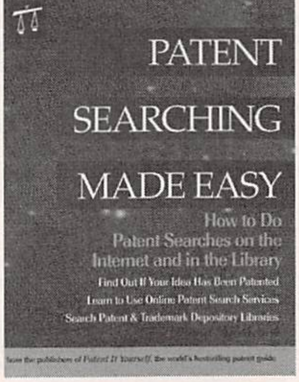
The second edition of this book adds over 50 pages of new material, as well as additional tables and 30 more illustrations. New chapters cover schematic capture; placement and routing, including information on the layout of analog, digital, and RF circuits; and an updated resource list. There are also reviews of products that have actually been used by the author in the production of printed circuit boards.

This book is designed for the home hobbyist or small-business owner. It describes a process that results in perfect single- and double-sided printed circuit boards with feature resolutions of 1-mils or less. The manual shows every step involved from schematic generation, component placement, routing, and artwork generation to the drilling and shaping of the boards. Artwork can consist of PC printouts or plain paper copies of magazine articles.

Patent Searching Made Easy

by David Hitchcock
Nolo Press
950 Parker Street
Berkeley, CA 94710
Tel: 510-549-1976
Fax: 510-548-5902
Web: www.nolo.com
$24.95

Whether you're an inventor or just thinking about marketing a new invention, you'll need to know if your idea has already been patented or produced—before filing a patent application and investing thousands of dollars in manufacturing and marketing costs. This book shows "would-be" inventors how to take advantage of the Internet to do patent searches—saving the cost of paying for a professional advisor.



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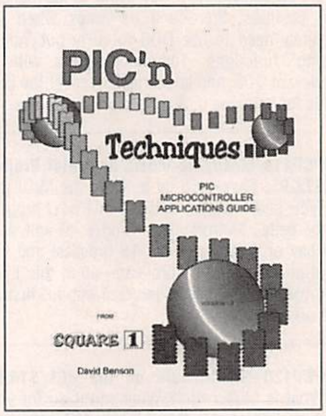
In this easy-to-use reference, readers learn specific Internet search techniques: how to take advantage of overlooked online patent resources, fine-tune searches with advanced Boolean logic and field codes, and apply the best search strategies for the two key patent sites—the online Patent and Trademark Office (PTO) and IBM sites. They will also discover how to search international patent offices on the Internet. The last step is going beyond the Internet and actually navigating through print and microfiche sources at Patent and Trademark Depository Libraries.

PIC'n Techniques

by David Benson
Square 1 Electronics
P.O. Box 501
Kelseyville, CA 94541
Tel: 707-279-8881
Fax: 707-279-8883
Web: www.sq-1.com
$34.95 plus $5 S&H

An intermediate-level applications guide covering Microchip Technology's PIC microcontrollers, the book describes the unique features of the 8-pin microcontrollers. The use of timer 1, timer 2, and the capture/compare/PWM (CCP) module is explained; followed by timing, counting, and pulse-width modulation (PWM) experiments. Further experiments show users how to design and build simple digital pulse and frequency



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generators, as well as time-interval and frequency measurement instruments.

The book also explains how to establish serial communication between a PIC chip and a PC via an RS-232 conversion circuit and a terminal program. These techniques are used in a digital voltmeter/data logger experiment for uploading data to a PC for display and for doing graphs using a spreadsheet program.

(Continued on page 95)

Budget Project and Computer Books

BP317–Practical Electronic Timing $6.99. Time measurement projects are among the most constructed gadgets by hobbyists. This book provides the theory and backs it with a wide range of practical construction projects. Each project has how-it-works theory and how to check it for correct operation.

BP415–Using Netscape on the Internet $8.99. Get with the Internet and with surfing, or browsing, the World Wide Web, and with the Netscape Navigator in particular. The book explains: The Internet and how the World Wide Web fits into the general scenario; how do you go about getting an Internet connection of your own; how to download and install the various versions of Netscape browsing software that are available; and how to use Netscape Navigator to surf the Web, and to find and maintain lists of usful sites. There's a heck of a lot more, too!

BP325–A Concise User's Guide to Windows 3.1 $6.99. Now you can manage Microsoft's Windows with confidence. Understand what hardware specification you need to run Windows 3.1 successfully, and how to install, customize, fine-tune and optimize your system. Then you'll get into understanding the Program Manager, File Manager and Print Manager. Next follows tips on the word processor, plus how to use Paintbrush. There's more on the Cardfile database with its auto-dial feature, Windows Calendar, Terminal, Notepad, etc.

BP327–DOS: One Step at a Time $5.99. Although you spend most of your time working with a word processor, spreadsheet or database, and are probably quite happy using its file management facilities, there will be times when you absolutely need to use DOS to carry out 'housekeeping' functions. The book starts with an overview of DOS, and later chapters cover the commands for handling disks, directories and files.

PCP119–Electronic Music and Midi Projects $12.95. Save cash by building the MIDI gadgets you need. Want a MIDI THRU box, program change pedal, Metronome, analog echo unit, MIDI patchbay or switcher? Over 16 practical and very useful music and MIDI projects—all in this book! The projects are explained in detail with full instructions on assembly.

PCP120—Multimedia on the PC! $14.95. What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well bring more fun, fun, fun into your leisure computer activities.

BP404–How To Create Pages for the Web Using HTML $7.99. Companies around the world, as well as PC users, are fast becoming aware of the World Wide Web as a means of publishing information over the Internet. HTML is the language used to create documents for Web browsers such as Mosaic, Net-scape and the Internet Explorer. These programs recognize this language as the method used to format the text, insert images, create hypertext and fill-in forms. HTML is easy to learn and use. This book explains the main features of the language and suggests some principles of style and design. Within a few hours, you can create a personal Home Page, research paper, company profile, questionnaire, etc., for world-wide publication on the Web.

BP377—Practical Electronic Control Projects $7.99. Electronic control theory is presented in simple, non-mathematical terms and is illustrated by many practical projects suitable for the student or hobbyist to build. Discover how to use sensors as an input to the control system, and how to provide output to lamps, heaters, solenoids, relays and motors. Also the text reveals how to use control circuits to link input to output including signal processing, control loops, and feedback. Computer-based control is explained by practical examples.

BP411—A Practical Introduction to Surface Mount Devices $6.99. This book takes you from the simplest possible starting point to a high level of competence in working with Surface Mount Devices (SMD's). Surface mount hobby-type construction is ideal for constructing small projects. Subjects such as PCB design, chip control, soldering techniques and specialist tools for SMD are fully explained. Some useful constructional projects are included.

BP136—25 Simple Indoor and Window Aerials $2.99. Many people live in flats and apartments where outdoor antennas are prohibited. This does not mean you have to forgo shortwave listening, for even a 20-foot length of wire stretched out under a rug in a room can produce acceptable results. However, with experimentation and some tips, you may well be able to improve further your radio's reception. Included are 25 indoor and window antennas that are proven performers. Much information is also given on shortwave bands, antenna directivity, time zones, dimensions, etc. A must book for all amateur radio enthusiasts.

BP379—30 Simple IC Terminal Block Projects $6.99. Here are 30 easy-to-build IC projects almost anyone can build. Requiring an IC and a few additional components, the book's 'black-box' building technique enables and encourages the constructor to progress to more advanced projects. Some of which are: timer projects, op-amp projects, counter projects, NAND-gate projects, and more.

BP401—Transistor Data Tables $7.99. The tables in this book contain information about the package shape, pin connections and basic electrical data for each of the many thousands of transistors listed. The data includes maximum reverse voltage, forward current and power dissipation, current gain and forward transadmittance and resistance, cut-off frequency and details of applications.

ETT1—Wireless & Electrical Cyclopedia $4.99. Step back to the 1920's with this reprinted catalog from the Electro Importing Company. Antiquity displayed on every page with items priced as low as 3 cents. Product descriptions include: Radio components, kits, motors and dynamos, Leyden jars, hot-wire meters, carbon mikes and more. The perfect gift for a radio antique collector.

BP93–Electronic Timer Projects $2.99. This book covers many of the possible applications of timer circuits. These circuits may turn on or off at either some preset time or after an elapsed time. Some of the more complicated timer and clock circuits are made up from a number of simpler circuits that the author deals with individually. Also included are several special interest circuits such as cars windshield wiper delay unit, a darkroom timer, metronome, etc.

BP88–How To Use Op-Amps $5.99. Written as a designer's guide covering many operational amplifiers, serving both as a source book of circuits and a reference book for design calculations. There are chapters on Meet the Operational Amplifier, Basic Circuits, Oscillators, Audio Circuits, Filters, Miscellaneous Circuits, Common Op Amps, Power Supplies and Construction Notes and Fault Finding.

BP76–Power Supply Projects $3.99. Presents a number of power-supply designs including simpled unbiased types, fixed voltage-regulated types and variable voltage stabilized designs. All are low-voltage types intended for use with semiconductor circuits. Apart from presenting a variety of designs that will satisfy most applications, the data in this book should help the reader to design his own power supplies. An essential addition to the experimenters electronics library.

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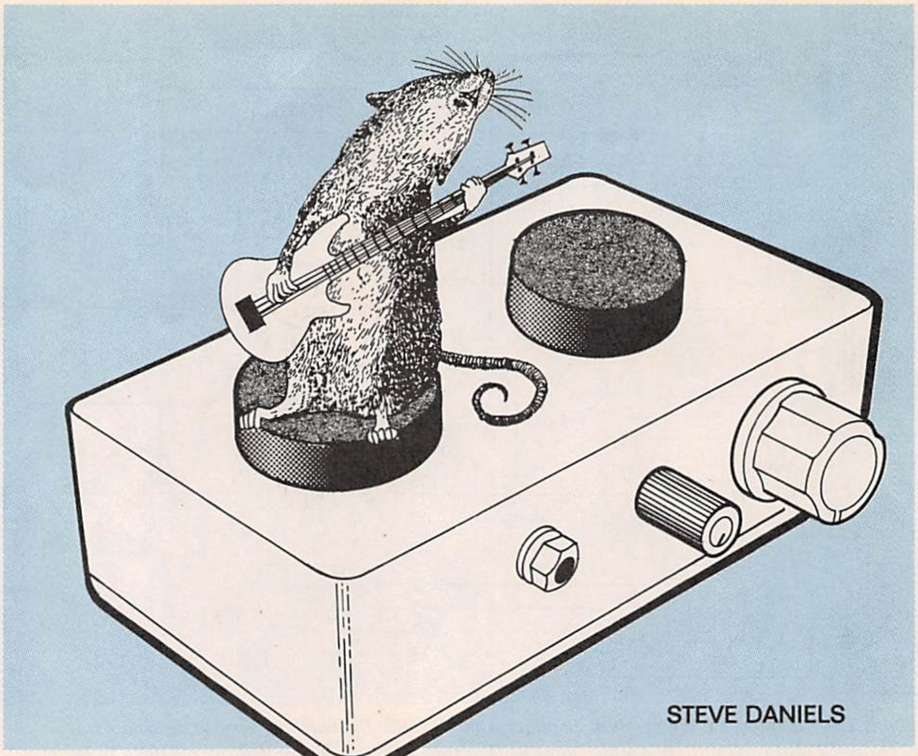
The Wild Mouse

Expand the types of sounds from your guitar with this simple "effects" box.



STEVE DANIELS

Thanks to falling prices for music-related electronics such as guitar sound effects, many different types of guitar pedals and boxes are available at very reasonable prices. Still, for those of us who enjoy both playing guitar and "rolling our own" electronics, tailoring the sound of our instruments with home-brewed effects remains a uniquely satisfying merging of both pastimes.

One basic type of circuit that is used for a variety of guitar effects is an active tone boost. That type of circuit is inexpensive to build from readily available components and is the basis of the Wild Mouse project presented here. It can be used to produce a variety of sounds from "twangy" to muffled. By switching the circuit in and out, the guitar's sound can instantly switch from lead playing to unmodified rhythm playing. The intensity of the effect can be varied by a potentiometer; an external control can also be used. Controlling the Wild Mouse with an expression pedal will yield "wah-wah" effects; a function generator can be used for automatic sweeping.

How It Works. The schematic diagram for the Wild Mouse is shown in Fig. 1; refer to it during the following discussion.

Audio from a guitar or other musical instrument is applied to J1. If S1 is in one position, the signal is sent directly to J2, bypassing the Wild Mouse circuit. With S1 switched the other way, the signal is coupled through C6 to IC1-a. The gain of that stage is set by R2.

For the moment, let's assume that R2 is set to its highest resistance; furthermore, the network formed by C1–C4, R10, and L1 are not a part of the circuit. With the values of R1 and R2 the same, IC1-a is a simple voltage amplifier with a gain of 1. If R1 were to drop in value or be bypassed, the stage gain would rise in proportion to the decrease in resistance to ground.

The circuit formed by C1–C4, L1, and R10 is a tuned circuit with a resonant frequency on the order of 1 kHz. That network bypasses R1, but does so most strongly around the resonant frequency or a harmonic of it. At those frequencies, the gain of the stage increases tremendously. Because of that gain increase, R2 is adjusted to clamp the gain to a point just below where the circuit would start oscillating. The result is a frequency-selective amplifier.

When used as a straight tone boost, R10 is adjusted for the amount of influence the resonant circuit has on the frequency response of the stage. In addition, one of the capacitors, C1–C4, is selected by S2. The result is that the tone can be adjusted between a more twangy or a more "muffled" effect. The tone-boosted output of IC1-a is further amplified by IC1-b. The amplified output is fed back through C9 and R9 to sharpen the peak of the frequency response.

Note that R10 is connected to the circuit through S3. That switch allows an external resistance to be connected through J3 to the circuit in place of R10. That way, an expression pedal or a function generator can be used in place of R10; that is how the "wah-wah" effect is produced. Sweeping the resistance more slowly and over a narrower range produces either a vibrato effect similar to a Leslie speaker or a spacey effect similar to phasing. For those who are not familiar with the name, a Leslie speaker is a speaker that is mounted on a motorized turntable; the setup is somewhat like a sound-based lighthouse. As the speaker begins to face away from the listener, the phase of the sound seems to undulate. While it is difficult to describe

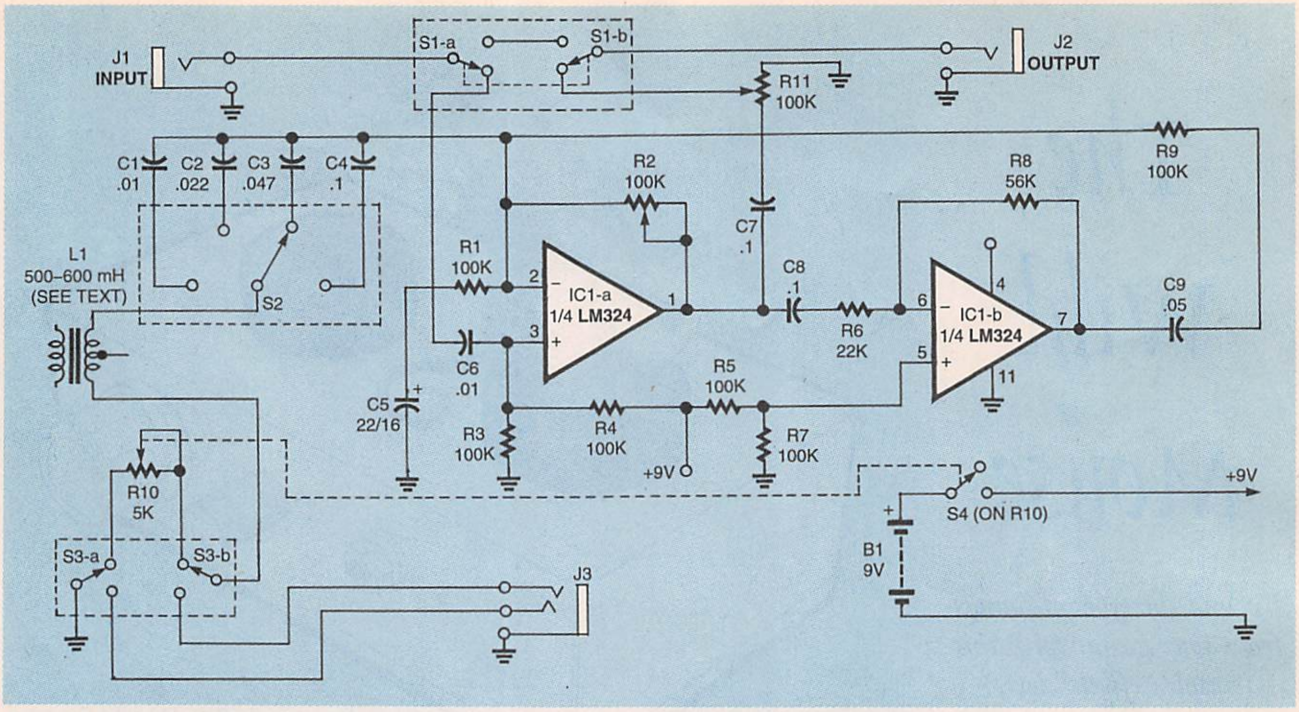


Fig. 1. The Wild Mouse is a tone-boost amplifier with feedback. By switching various capacitor values with S2 and varying R10, a wide range of tone responses can be created. By plugging in an external resistance such as a foot pedal to J3, the Wild Mouse can be used as a "wah-wah" effect.

the effect, it is very easy to recognize it once it is heard.

The modified output is coupled to J2 through C7. Potentiometer R11 keeps the overall amplification of the Wild Mouse from overdriving any amplifier connected to J2; guitar pickups vary in output from model to model and all amplifier inputs are not equally sensitive. The raw output level of the Wild Mouse can be quite high and might overdrive some amplifiers.

The Wild Mouse is powered by a 9-volt battery that is switched by S4.

Construction. Due to the noise-sensetive nature of audio circuits, the Wild Mouse is best built on a printed-circuit board to help cut down on any stray noise pickup. Foil patterns have been included here. A pre-etched and drilled PC board is also available from the source given in the Parts List. If you use that board or etch one from the foil pattern, use the parts-placement diagram in Fig. 2 when populating it.

Note that the PC pattern was designed so that the suggested parts for S1, S3, S4, and R10 could be mounted directly to the board. If you are using components that are different in physical size, you might have to mount them to the case and connect them to the PC board with short lengths of insulated wire. Another unusual aspect of S1 and S3 is that while the switches themselves are symmetrical with respect to their pins, they have mounting tabs that are *not* symmetrical. Unconnected pads are included in the foil pattern to locate those mounting holes; simply drill them out to match the

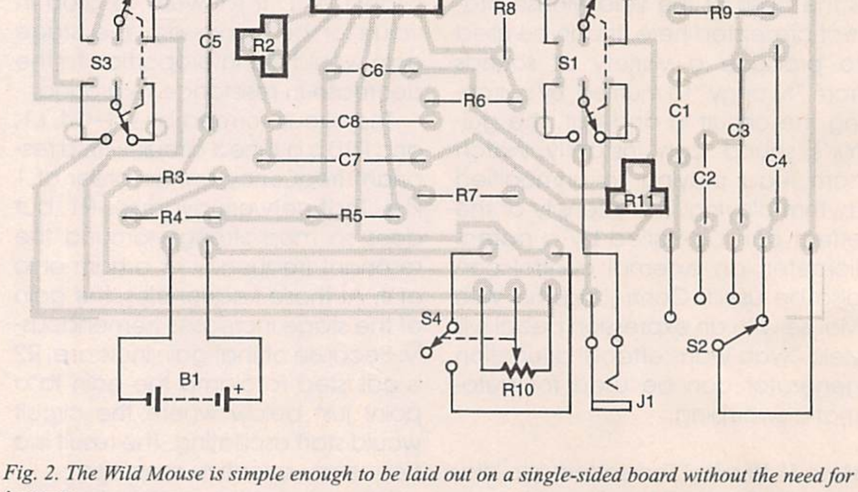


Fig. 2. The Wild Mouse is simple enough to be laid out on a single-sided board without the need for jumpers.

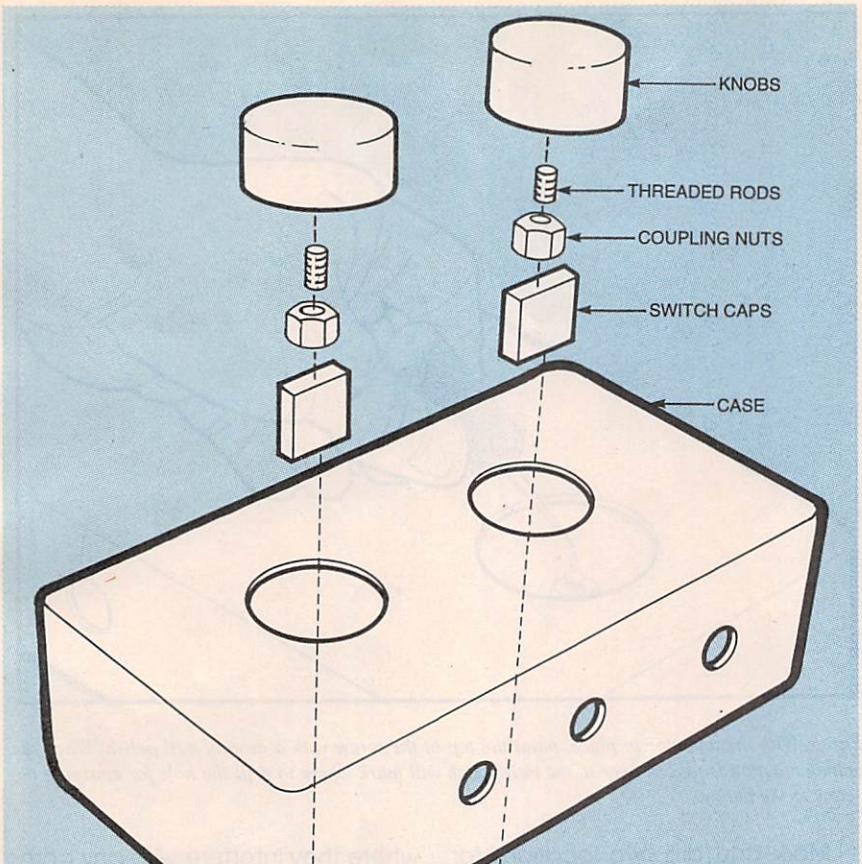


Fig. 3. The entire Wild Mouse fits into a small box. With a strong enclosure and robust actuators for S1 and S3, the Wild Mouse can be used as a foot-controlled "stomp box."

mounting tabs.

Also note the unusual source for L1. The advantage of using one side of an audio transformer instead of a choke is that the part specified is readily available, cheap, and works well. While a true 500-mH choke produces (to the author's ears, anyway) a slightly more mellow sound, it was much too physically large to be used in the prototype's case.

The rotary switch specified for S2 is an off-the-shelf item from RadioShack. Using such a two-pole, six-position device for a one-pole, four-position requirement has the advantage of low cost, wide availability, and most importantly, small size. The potentiometer/switch combination recommended for R10/S4 is small enough to make for easy assembly, but bear in mind that it has a 1/8-inch shaft rather than the more usual 1/4-inch variety. Suitable knobs are available, but they might be a bit more expensive. If you want the knob for R10 to be at the same level as S2, you will need to mount R10 somewhat above the board; flush-mounting R10 will result in the controls not being even. Also note that the shafts for the controls should be cut down to a length of about 1/2 inch before soldering to them.

The jacks, S2, and the battery clip for B1 are connected with lengths of insulated wire. Once the wires are soldered to the PC board, a dab of epoxy makes a good strain relief; those wires might be stressed during final assembly and subsequent replacements of the battery. Once everything has been soldered, examine your work carefully for any construction errors such as cold-solder joints, broken wires, missing or incorrect parts, or polarized components that have been installed backwards.

Testing. The Wild Mouse is easiest to test before mounting in a case. Connect a 9-volt battery to the battery clips and an amplifier to J2. Set S3 so that R10 is connected to the circuit. With R2 set to its minimum resistance and the amplifier at low volume, turn R10 (switching S4 on) up to about / of its rotation and press S1. With a small screwdriver, slowly raise the resistance of R2. At some point, you should hear very loud feedback. Back off slightly from that setting. Rotate R10 from maximum to minimum resistance, and you should hear a rushing sound that varies in pitch as the resistance is lowered. You can now connect a guitar to J1 and see how the effect sounds before working on the case.

Troubleshooting. The Wild Mouse is a simple circuit; very little can go wrong. Should there be some sort of problem, it is most often caused by—in the author's personal experience—a wiring error. If you etched your own PC board, check the con-

tinuity of every connection with an ohmmeter. Be sure that all resistor values are correct and that the right values are in the right places. Use a voltmeter to make sure that pin 4 of IC1 is getting 9 volts and that pins 3 and 5 are each getting about 4.5 volts. If the unit passes all of those checks turn out fine and you still have trouble, break the feedback loop by disconnecting C9 temporarily. Use a guitar amp as a signal tracer and see if you can find where the signal is being lost. You should hear a boosted signal at pin 1 of IC1, but without the sharpness that feedback adds. You should hear the same signal, but louder, at pin 7. If those tests pass, reconnect C9 and continue troubleshooting the feedback loop. Once any problems are cleared up, you can finish construction of the Wild Mouse.

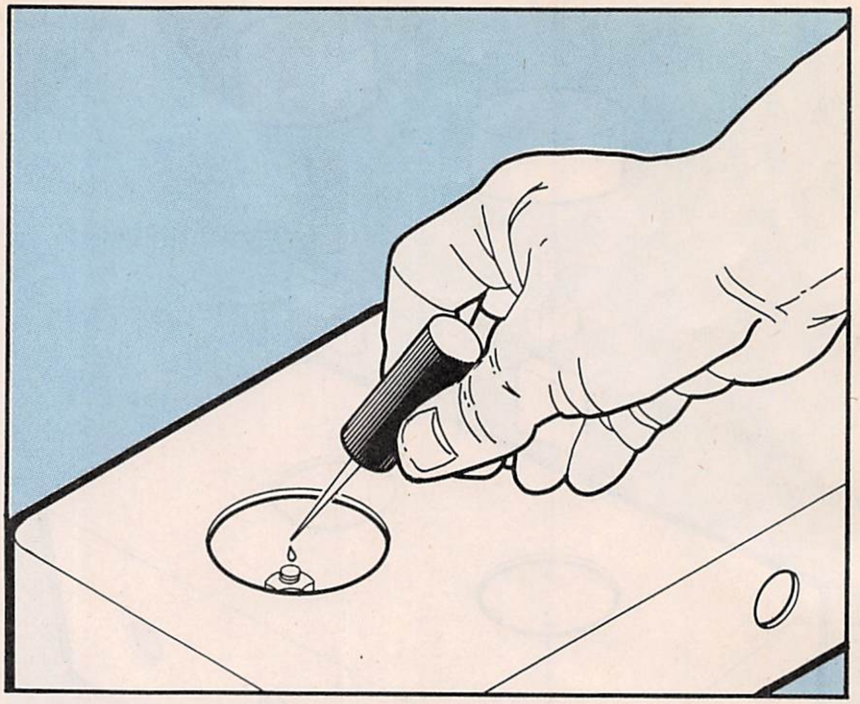


Fig. 5. With the actuator in place, paint the top of the screw with a drop of nail polish. When the actuator button is placed over it, the nail polish will mark where to drill the hole for epoxying the screw to the button.

Final Assembly. The Wild Mouse should be mounted in a rugged case that can take being stepped on and kicked around on stage. The author's prototype used a cast aluminum box. That case (Jameco no. 11965) is small, very rugged, and gives the unit a compact, professional appearance. Note that if you have made substitutions of components such as switches and controls, you might have to use a case that is larger. In any event, the case that you use should be strong.

The general arrangement of the Wild Mouse parts is shown in Fig. 3. Note that the PC board is mounted to the lid of the case and that the case itself is used as a "cover." Using the case upside down gives the Wild Mouse a more "jazzy" look, and as any musician will tell you, style is important.

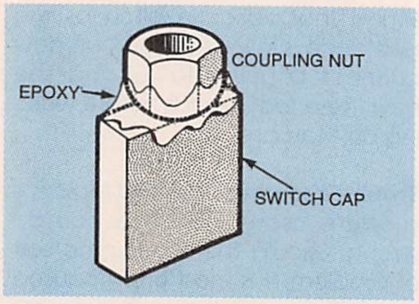


Fig. 4. The actuators are made from a snap-on switch cap with a short coupling nut that's epoxied to it.

Mark and drill two locations for mounting screws on the lid and the PC board. The screws are mounted to the lid with nuts, which will act as standoffs for the PC board. Before securing the board in place with two more nuts, mark the locations of S1 and S3. Cut down two adhesive rubber feet to the thickness of the "standoff" nuts. Attach those "backstops" to the inside of the lid so that they will be directly underneath S1 and S3 when the PC board is in place. That will give the PC board some protection from being accidentally flexed should someone activate one of the switches a little too enthusiastically. Fasten the board down, checking that the backstops are not so high as to bend the board; file them down if necessary.

Drill holes in the case for the jacks and switches. The locations of most of those parts are not critical as long as there is clearance within the case; the exception is R10/S4. Since that component is mounted to the PC board and the PC board is mounted to the lid, you must drill its mounting hole accurately. If you are working with a case that has structural ribs cast into it, don't forget to file or grind them smooth where they interfere with any components being mounted to the case.

Once it is mounted within its case, it would be a good idea to check the Wild Mouse again to make sure that nothing has gone wrong in the process such as broken wires or short circuits. Before closing the case, check that S1 is down and S3 is up. Once you're sure that everything works, it's time to work on the actuators for S1 and S3.

"Feetswitches." Providing rugged, inexpensive, compact, true-bypass switching for a musical-instrument sound effect has always been problematic. One method used by some manufacturers is to use a light-duty switch and a robust actuator that is often a part of the case itself. That method was adapted for the Wild Mouse in a way that needs little machining; some common bits of plastic and epoxy produces usable results.

The switches specified for S1 and S3 are used for instrumentation applications. They provide double-pole double-throw switching in a push-on/push-off arrangement and are designed to mount directly on a PC board. A variety of snap-on

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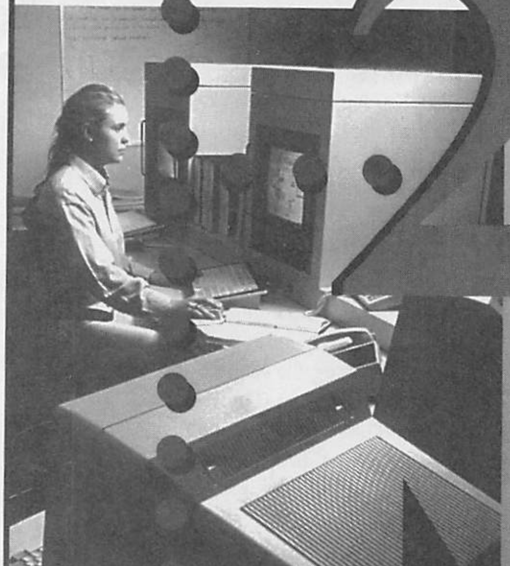

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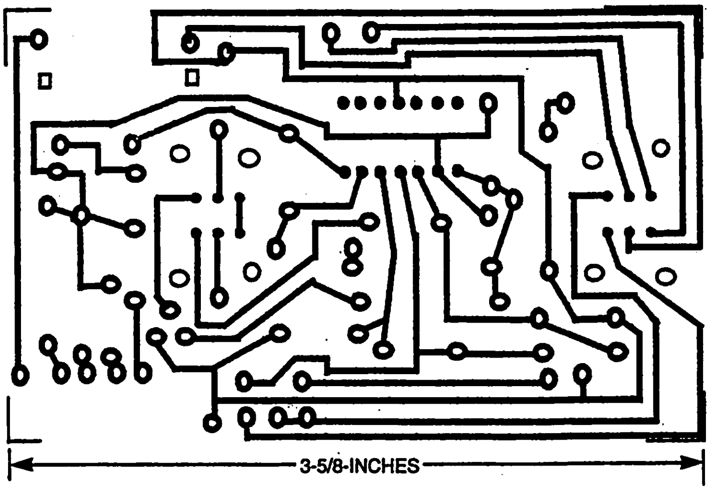


Here's the foil pattern for the Wild Mouse. Note the pads that do not have any traces connected to them. Those pads indicate where mounting holes are to be drilled for S1, S3, and L1. Also note that the mounting holes for the switches are not symmetrical.

caps are available for them; the suggested unit makes a good basis for an actuator.

Start by opening the Wild Mouse and snap the caps on to S1 and S3. Measure the exact positions of the centers of the caps with respect to the edges of the lid, and use these measurements to mark the points on the cover for the centers of the large holes.

The ideal tool for making those holes is a punch, such as a Greenlee socket punch. Those punches come in various sizes and shapes; use a diameter that is slightly larger in diameter than the buttons that you will be using. It is also possible to use a nibbling tool; make each hole slightly smaller than the diameter of a button (more on that in a moment), enlarging them to the correct size using a small file with a curved edge. Test the diameter of the hole by holding a button against it until the button just passes freely.

The buttons that were used in the prototype Wild Mouse are 1-1/8-inch-diameter by 3/8-inch thick acrylic discs. Such discs can be found in a well-stocked plastic-supply house. An alternative is to use a bottle cap from a cardboard juice container. Fill the cap with layers of epoxy or auto-body filler until it is completely filled. File the bottom "lip" off the cap and the button is ready for use in the Wild Mouse.

Roughen the surface of the switch caps and the outside of a pair of 4-40 by 1/4-inch coupling nuts with fine sandpaper. Mix up a small amount of quick-drying epoxy and apply a small dab to the top of the caps. Place the spacers into the glue. With the cover in place, center the spacers to the button holes as closely as you can. The completed caps should look like the illustration shown in Fig. 4.

When the epoxy is dry, run a 4-40 by 1/4-inch screw finger-tight and all the way into the spacers. Place a tiny dab of nail polish on the screw head (see Fig. 5). Drop a button gently on the screw; the nail polish will mark the position of the screw head.

Drill a hole in the bottom of the button where the nail polish marked it. The diameter of the hole should be just large enough to fit the screw head; 7/32-inch should do for a 4-40 screw. Drill the hole as close to perfectly vertical as possible. The depth should be about 1/3 to fi of the button's thickness.

Clean the nail polish from the screw heads. Screw them back into the coupling nuts and apply a dab of epoxy to the heads. Place the buttons over the screws, clamping them in place until the glue sets. Be sure that the button is as close to parallel with the top of the case as possible and centered in its hole. When the glue has set, test the assembly by pressing the button gently once or twice. The button

PARTS LIST FOR THE WILD MOUSE

RESISTORS

(All resistors are 1/4-watt, 5% units, unless otherwise noted.)

R1, R3–R5, R7, R9—100,000-ohm
R2, R11—100,000-ohm trimmer potentiometer, PC-mount
R6—22,000-ohm
R8—56,000-ohm
R10—5000-ohm potentiometer with integral single-pole, single-throw switch, panel-mount (Digi-Key CT-2226 or similar)

CAPACITORS

C1, C6—0.01-µF, Mylar (see text)
C2—0.022-µF, Mylar (see text)
C3—0.047-µF, Mylar (see text)
C4, C7, C8—0.1-µF, Mylar (see text)
C5—22-µF, 16-WVDC, electrolytic
C9—0.05-µF, Mylar

ADDITIONAL PARTS AND MATERIALS

B1—9-volt battery
IC1—LM324 quad op-amp, integrated circuit
J1, J2—1/4-inch mono phone jack, panel-mount
J3—1/8-inch stereo phone jack, panel-mount
L1—500- to 600-mH choke (RadioShack 273-1380—see text)
S1, S3—Double-pole, double-throw switch, PC-mount (DigiKey EG-1016ND or similar)
S2—Single-pole, four-throw rotary switch (RadioShack 275-1386—see text)
S4—Single-pole, single-throw switch (part of R10)
Case, knobs, switch caps (Digi-Key EG-1088-ND), wire, hardware, etc.

Note: The following items are available from Small Bear Electronics LLC, 123 Seventh Ave, Suite 156, Brooklyn, NY 11215: Kit of all parts including etched PC board and unfinished case except for actuator materials, $31.25; Etched and drilled PC board, $6.00. Add $6.00 to kit for substitute S2 with 1/2-inch shaft. Please add $6.00 for shipping/handling on kit; $1.00 for PC board. Priority Mail is available on PC board for $3.00. New York State residents must add 8 1/4% sales tax.

should not bind at any point. If the actuator works freely, unscrew the buttons gently; do not get them mixed up. Fill in the screw hole with some more epoxy so that it is level with the surface of the button. Be careful not to get any glue on the screw threads that are not within the hole. When the glue has set, screw the button back on and test them again. If everything is okay, unscrew the buttons once again, take the cap off the switches, and add more epoxy around the spacer and coupling nut to reinforce the bond.

With the Wild Mouse complete, the finishing touch is to clean up the case and finish it as you see fit. When everything is done and the unit reassembled, the Wild Mouse is ready for use.

Using the Wild Mouse. Most of the ways to use the Wild Mouse have already been mentioned. For those who would like to experiment with phasing and "wah-wah" effects, here are a few quick suggestions.

The most important factor for getting a good live wah-wah sound is being able to drop the resistance in the tank circuit from about 5000 ohms to as close as possible to zero with a relatively small vertical movement of a pedal. If you have a potentiometer-based pedal, use an audio-taper pot of 5000 to 10,000 ohms. If your pedal uses an LED and a photocell, the LED should be bright; the photocell needs to have the lowest possible "on" resistance.

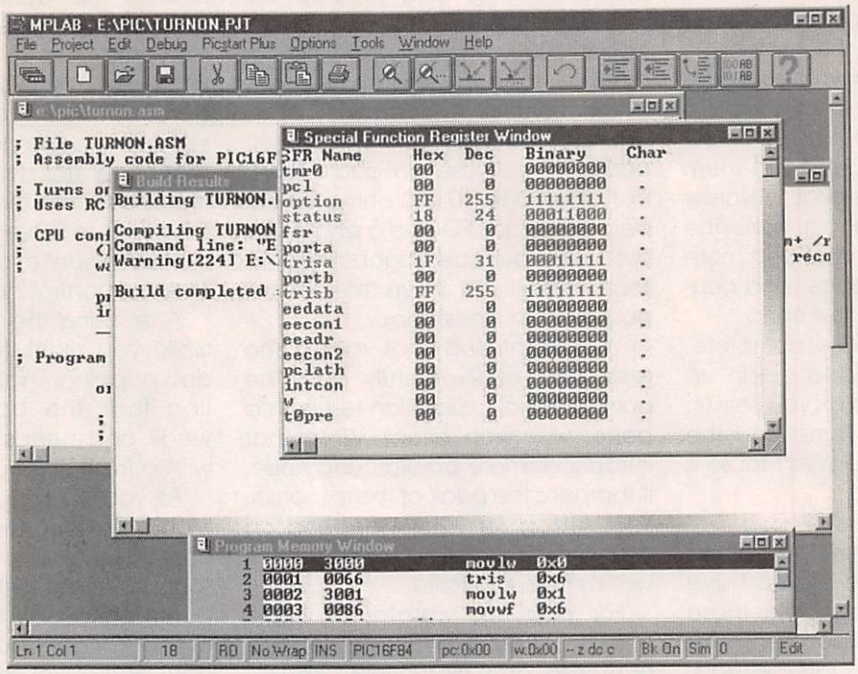
You might find that raising the resistance of R2 slightly past the point of initial calibration results in a better wah-wah effect. While that introduces more background noise, it sharpens the peak of the response. Your setting for R2 will depend on your most common application as well as personal taste.

For phasing, vibrato, or Leslie effects, a relatively low-resistance photocell and high-brightness LED will work well. An interesting method to slow the speed of change is with the use of incandescent lamps. Process the audio signal through several Wild Mice (Wild Mouses?) and then mix it with the original unmodified signal; the result is a stereo chorusing effect. Try triggering an envelope generator (a circuit that generates a signal shape when triggered) from the guitar input, use the result to drive an LED, and put the LED in front of a photocell on the external control input: Auto-Wah!

After using the Wild Mouse for a while, you might start to hear hissing and popping. That is the first indication that the battery is getting weak and needs to be replaced with a fresh one!

As you explore all that the Wild Mouse has to offer, no doubt you'll come up with some amazing sounds yourself. If you have any comments or suggestions, the author can be reached at stevedanls@aol.com. Ω

PIC Assembly Language



for the Complete Beginner

Microcontrollers have revolutionized the world of electronics, but they are useless to you if you don't know how to program them. This month, we show you how easy that is to do.

MICHAEL A. COVINGTON

These days, the field of electronics is divided into "haves" and "have-nots"—people who can program microcontrollers and people who can't. If you're one of the "have-nots," this article is for you.

Microcontrollers are one-chip computers designed to control other equipment, and almost all electronic equipment now uses them. The average American home now contains about 100 computers, almost all of which are microcontrollers hidden within appliances, clocks, thermostats, and even automobile engines.

Although some microcontrollers can be programmed in C or BASIC, you need assembly language to get the best results with the least expensive micros. The reason is that assembly language lets you specify the exact instructions that the CPU will follow; you can control exactly how much time and memory each step of the program will take. On a tiny computer, this can be important. What's more, if you're not already an experienced programmer, you may well find that assembly language is *simpler* than BASIC or C. In many ways it's more like designing a circuit than writing software.

The trouble with assembly language is that it's different for each kind of CPU. There's one assembly language for Pentiums, another for PIC microcontrollers, still another for Motorola 68000s, and so forth. There are even slight differences from one model of PIC to another. And that leads to a serious problem—each assembly-language manual seems to assume that you already know the assembly language for some other processor! So as you look from one manual to another in puzzlement, *there's no way to get started.*

That's the problem this article will address. We won't teach you all of PIC assembly language; just enough to get you started. For simplicity, deal with just one processor, the PIC16F84. To be *very* precise, it will be the PIC16F84-04P, which operates up to 4 MHz and is housed in a plastic DIP package. This is a product of Microchip, Inc. (Chandler, Arizona, Web: www.microchip.com), and it's closely related to the rest of the PIC family.

What You'll Need. To do the experiments described in this article, you'll need one or more PIC16F84-04P chips; we strongly recommend having more than one so you can rule out a damaged PIC if your circuit doesn't work. You'll also need

Michael Covington does research on advanced microcontroller applications at the University of Georgia's Artificial Intelligence Center. He also conducts the monthly "Q&A" section in **Electronics Now** Magazine.

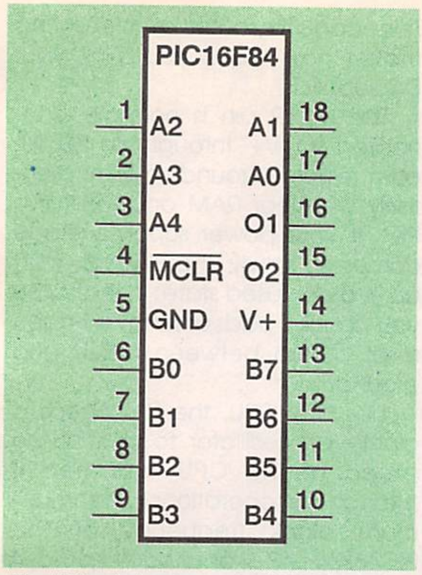


Fig. 1. Here's the pinout of a 16F84 PIC microprocessor that's being used as our example device.

the other parts for the circuits you want to build (refer to the schematics as we go along). And you'll need a PC-compatible personal computer, the MPASM assembler software (which you can download from www.microchip.com), and a PIC programmer such as Ramsey Electronics' PICPRO (available for $59.95 plus $6.95 postage and handling in the U.S. from Ramsey Electronics, 793 Canning Parkway, Victor, NY 14564, Tel: 716-924-4560, Fax: 716-924-4886, Web: www.ramseyelectronics.com), which is based on this author's NOPPP programmer published in the September 1998 issue of this magazine and described at www.mindspring.com/~covington/noppp. The PIC16F8X data sheet, actually a 122-page manual, will also come in handy; it's called PIC16F8X because it covers both PIC16F84 and PIC16F83, and you can download it or request a printed copy from Microchip.

LISTING 1

```
; File TURNON.ASM
; Assembly code for PIC16F84 microcontroller

; Turns on an LED connected to B0.
; Uses RC oscillator, about 100 kHz.

; CPU configuration
;   (It's a 16F84, RC oscillator,
;   watchdog timer off, power-up timer on.)

    processor 16f84
    include         <p16f84.inc>
    __config _RC_OSC & _WDT_OFF & _PWRTE_ON

; Program

    org     0           ; start at address 0

    ; At startup, all ports are inputs.
    ; Set Port B to all outputs.

    movlw B'00000000'        ; w := binary 00000000
    tris    PORTB            ; copy w to port B control reg

    ; Put a 1 in the lowest bit of port B.

    movlw B'00000001'        ; w := binary 00000001
    movwf PORTB              ; copy w to port B itself

    ; Stop by going into an endless loop

fin:    goto    fin

    end                      ; program ends here
```

What's Inside a PIC? The pinout of the PIC16F84 is shown in Fig. 1, and Fig. 2 shows the most important parts inside of the device. The PIC is a tiny but complete computer. It has a CPU (central processing unit), program memory (PROM), working memory (RAM), and two input-output ports.

The CPU is, of course, the "brain" of the computer. It reads and executes instructions from the program memory. As it does so, it can store and retrieve data in working memory (RAM). Some CPUs make a distinction between registers located within the CPU and RAM located outside it; the PIC doesn't, and its general-purpose working RAM is

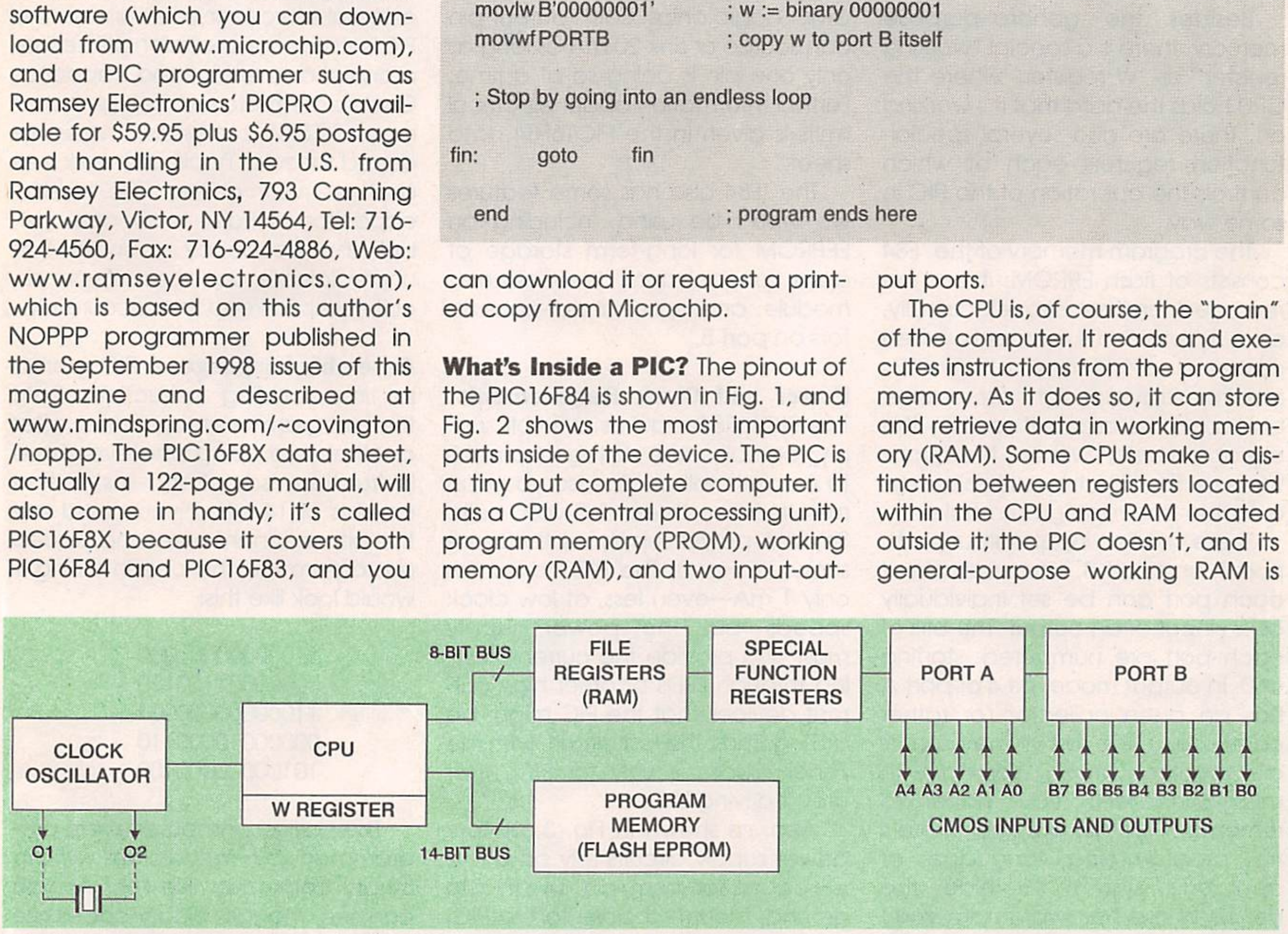


Fig. 2. As you can see from this simplified block diagram of the 16F84, the device is essentially a one-chip computer.

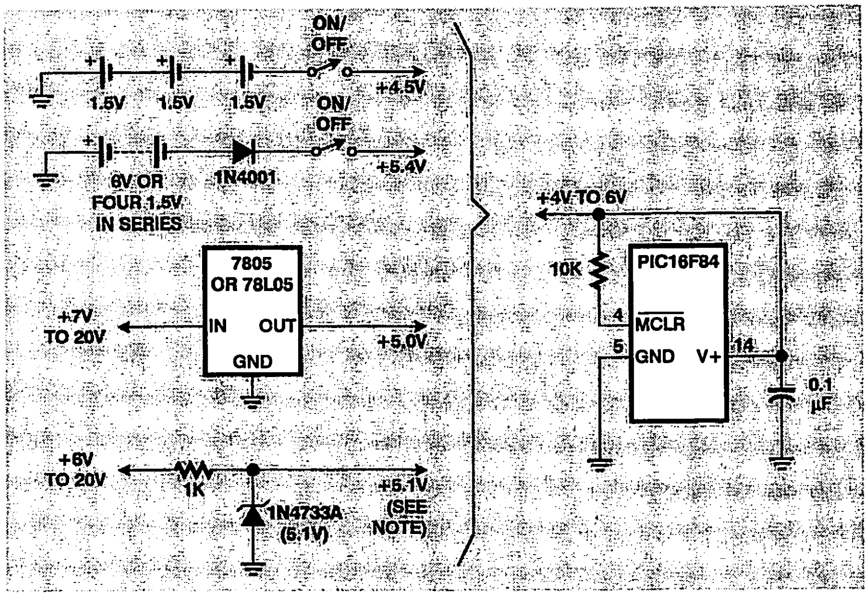


Fig. 3. Any of the four schemes on the left can be used to power a PIC, though the last one should only be used where the device is not driving an LED or a high-current load. Regardless of which power scheme you use, it is important to connect a 0.1-µF capacitor to pin 14 as shown on the left.

also known as "file registers." On the 'F84, there are 68 bytes of general-purpose RAM, located at addresses hex 0C to hex 4F.

Besides the general-purpose memory, there is a special "working register" or "W register" where the CPU holds the data that it's working on. There are also several special-function registers each of which controls the operation of the PIC in some way.

The program memory of the 'F84 consists of flash EPROM; it can be recorded and erased electrically, and it retains its contents when powered off. Many other PICs require ultraviolet light for erasure and are not erasable if you buy the cheaper version without the quartz window. The 'F84, however, is always erasable and reprogrammable.

There are two input-output ports, port A and port B, and each pin of each port can be set individually as an input or an output. The bits of each port are numbered, starting at 0. In output mode, bit 4 of port A has an open collector (or rather open drain); the rest of the outputs are regular CMOS. (Working with microcontrollers, you have to remember details like this; there's no programming language or operating system to hide the details of the hardware from you.) The CPU treats each port as one 8-bit byte of data even though only five bits of port A are actually brought out as pins of the IC.

PIC inputs are CMOS-compatible; PIC outputs can drive TTL or CMOS logic chips. Each output pin can source or sink 20 mA as long as only one pin is doing so at a time. Further information about electrical limits is given in the PIC16F84 data sheet.

The 'F84 also has some features we won't be using, including an EEPROM for long-term storage of data, an onboard timer-counter module, and optional pull-up resistors on port B.

Power and Clock Requirements. The PIC16F84 requires a 5-volt supply; actually, any voltage from 4.0 to 6.0 volts will do fine, so you can run it from three 1.5-volt cells. Several power-supply options are shown in Fig. 3. The PIC consumes only 1 mA—even less, at low clock speeds—but the power supply must also provide the current flowing through LEDs or other high-current devices that the PIC might be driving. Thus, the last circuit, with the Zener diode, is only for PICs that aren't driving LEDs.

Also, as shown in Fig. 3, all four power supply circuits rely on a 0.1-µF capacitor from pin 14 (V+) to ground, mounted close to the PIC, to protect the PIC and adjacent components from electrical noise. This capacitor should be present no matter how clean you think your DC supply is.

The MCLR pin is normally connected to V+ through a 10,000-ohm resistor. Grounding it momentarily will clear RAM and reset the PIC. If your power supply voltage comes up slowly, the PIC may start up in a confused state; in that case you should add a normally-open reset button between MCLR and ground.

Like any CPU, the PIC needs a clock—an oscillator to control the speed of the CPU and step it through its operations. The maximum clock frequency of the PIC16F84-04P is, as already noted, 4 MHz. There is no lower limit. Low clock frequencies save power and reduce the amount of counting the PIC has to do when timing a slow operation. At 30 kHz, a PIC can run on 0.1 mA.

A selection of the most popular clock circuits is shown in Fig. 4. The clock signal can be fed in from an external source, or you can use the PIC's on-board oscillator with either a crystal or a resistor and capacitor. Crystals are preferred for high accuracy; 3.58-MHz crystals, mass-produced for color TV circuits, work well and are very cheap. The resistor-capacitor oscillator is cheaper yet, but the frequency is somewhat unpredictable; don't use it if your circuit needs to keep time accurately.

Assembly Language. A PIC spends its time reading instructions from the program memory, one after another, and doing whatever those instructions say. Each instruction consists of 14 bits. If you could see the bits as binary ones and zeroes, a program like the one in Listing 1 would look like this:

```
11000000000000
00000001100110
11000000000001
00000010000110
10100000000100
```

The earliest computers were programmed by technicians writing binary codes just like this. As you can see, though, binary codes are very hard for human beings to read or write because they're complete-

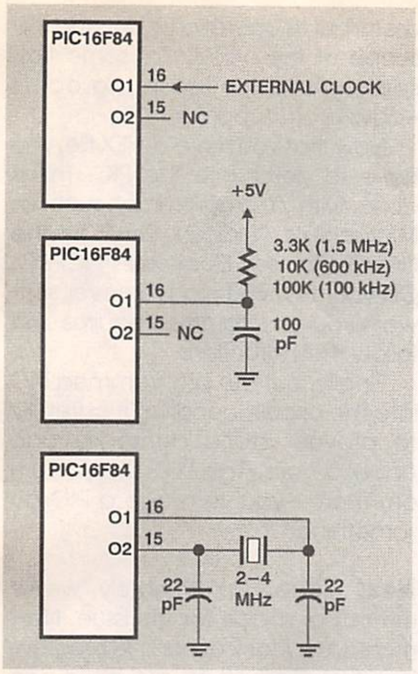


Fig. 4. Three ways are shown to generate the clock signal that is required by the PIC.

ly arbitrary; they look like gibberish.

Another reason binary codes are hard to write is that many of them refer to locations in memory. For instance, a "go to" instruction will have to say what memory address to jump to. Programming would be much easier if you could label a location in the program and have the computer figure out its address.

For both of those reasons, *assembly language* was invented over forty years ago. Or, to be more precise, many assembly languages have been invented, one for each type of CPU. What assembly languages have in common is that the instructions are abbreviated by readable codes (*mnemonics*) such as GOTO, and locations can be represented by programmer-assigned labels. For example, in assembly language, the binary instructions just mentioned would be:

```
        movlw  B'00000000'
        tris   PORTB
        movlw  B'00000001'
        movwf  PORTB
fin:    goto   fin
```

In English: Put the bit pattern 00000000 into the W register and copy it to the tri-state control register for port B, thereby setting up port B for output; then put 00000001 into W and copy it to port B itself; and finally stop the program by going into an endless loop. The result from the outside world's point of view is that pin 6 of the 'F84 goes high, while pins 7 through 13 remain low.

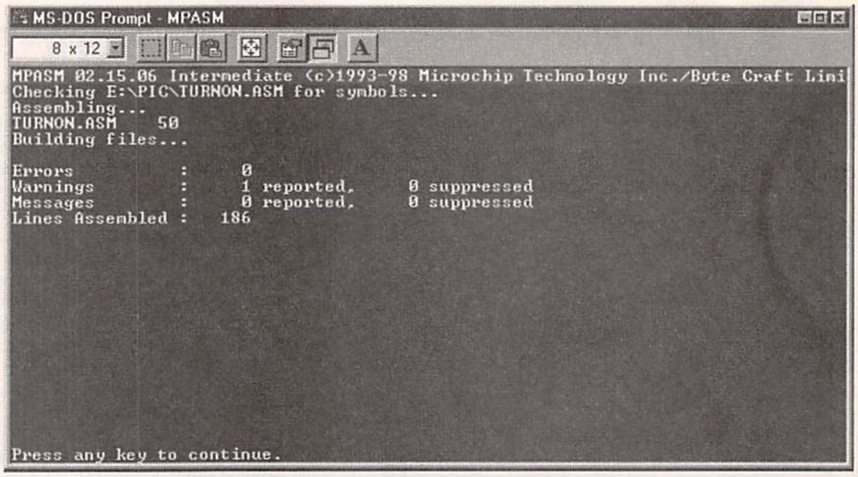


Fig. 6. To assemble the program in Listing 1, you'll need MPASM, a free program downloadable from www.microchip.com, or a similar PIC assembler.

Program Layout. Listing 1 shows a complete, ready-to-assemble program. Look closely at its layout. The semicolon (;) is the comment marker; the computer ignores everything after the semicolon on each line. Much of the program consists of comments; that's as it should be, because although it's not as bad as binary code, assembly language is still relatively hard to read.

Each instruction is divided into three parts, the label, the opcode (operation code or instruction code), and the operand (also called argument). For example, in the line:

```
fin: goto fin
```

the label is fin: (with a colon), the opcode is goto, and the operand is fin.

The label, opcode, and operand are separated by spaces. The assembler doesn't care how many spaces you use; one is enough, but most programmers use additional spaces to make their instructions line up into neat columns.

If there's no label, there must be at least one blank before the opcode, or the assembler will think the opcode is a label. Although current PIC assemblers can often recover from this kind of error, it is an error, and other assemblers aren't as tolerant.

Assembling a Program. A computer "assembles" the assembly-language program into the binary instructions, which, for brevity, are actually written in hexadecimal (more about that shortly) and stored in what is called a .HEX file. Some computers run their own assemblers, but the PIC is far too small for that; instead, you'll type and assemble your PIC programs on a DOS or Windows PC. Then you'll download the .HEX file into a PIC using a PIC programmer and its associated software.

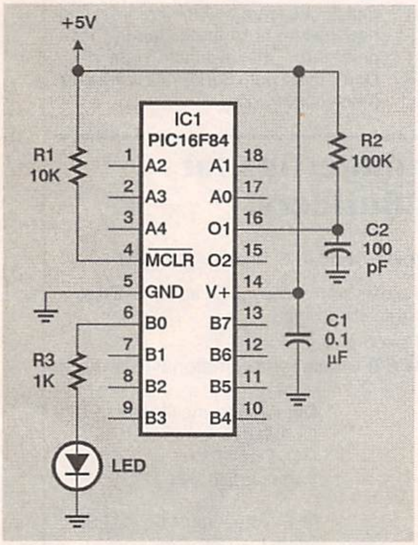


Fig. 5. Here's the circuit that accompanies program Listing 1.

The program in Listing 1 does one very simple thing—it turns on an LED connected to pin B0. The circuit needed to try this program out is shown in Fig. 5. Admittedly, turning on one LED is not a great feat of computation, but it's enough to show that the PIC works.

To assemble this program, you'll need MPASM, the free PIC assembler downloadable from www.microchip.com. You also need the file P16F84.INC, which comes with MPASM and tells the assembler the particulars of the 'F84 as opposed to the numerous other varieties of PIC. You won't need the other .INC files also included with the assembler.

What you do is type your program onto a file with a name ending in .ASM, using Windows Notepad, DOS EDIT, or any other text editor. Don't use a word processor unless you are sure you can save your file as plain ASCII.

Then run MPASM from a DOS prompt (a DOS box under Windows is OK). If your program file is named turnon.asm, type the command:

```
mpasm turnon.asm
```

and Fig. 6 shows what you'll see on the screen.

What MPASM is telling you is that it assembled your .ASM file, generating one warning message (which is unimportant—more about this next month) results consists of a .HEX file containing the assembled instructions and a .LST file containing a detailed program listing with error messages. If the program contained serious errors, no .HEX file would be generated and you should study the .LST file to see what went wrong.

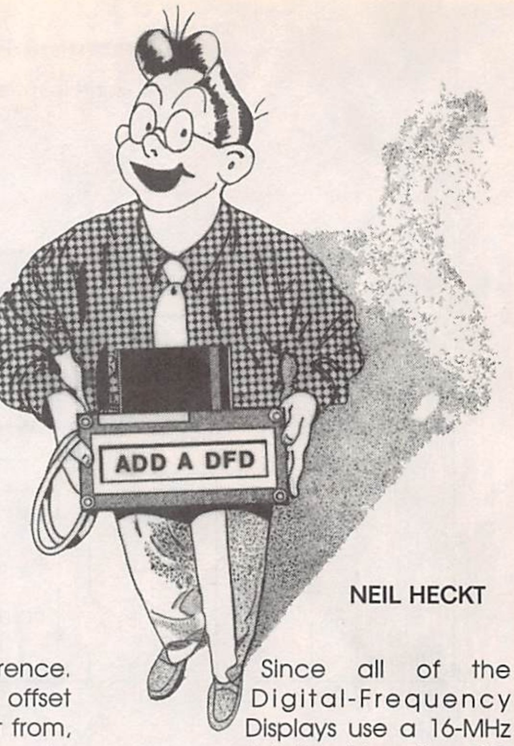
MPASM is the simple way to go. Microchip also gives away a development environment called MPLAB (shown at the beginning of this article) that contains an assembler plus a simulator so you can make your PC pretend to be a PIC and actually see your program run. MPLAB is very useful but its operation is beyond the scope of this article. For some tips, see www.mindspring.com/~covington/noppp.

Now that you have a .HEX file, you have to get it into the PIC. This is done with a programmer such as Microchip's "Picstart Plus" or the NOPPP/Ramsey Electronics PICPRO. On your PC, you run whatever software your programmer requires and follow the instructions.

Finally, put the programmed PIC into the circuit (handling it carefully to prevent static damage) and apply 5 volts. The LED should turn on. There—you've made a PIC do something.

Next Time. Unfortunately, we've run out of space for this issue. Next month, we'll look at our little program in more depth, then see if we can tackle something that's a little more ambitious. We'll also look at some resources you can use to extend your new-found ability to program microprocessors even further. Ω

Add a Digital-Frequency Display to Your Equipment



One of these PIC-based displays can be added to almost any receiver, transmitter, or piece of test equipment.

NEIL HECKT

While a frequency counter is a handy piece of test equipment to have when working with a piece of equipment on a bench, having such an item built into a radio, for example, would make a very useful tuning indicator. There are many examples of modern equipment that sport the latest digital display. Some of those displays go way beyond the simple ability of a digital-frequency readout. In fact, some of the features integrated into those displays almost qualify them as full-featured frequency counters in their own right.

It would be wonderful to have one of those state-of-the-art devices; justifying it, on the other hand, can be difficult. If you have a unit that works well with little or no trouble or repairs, why take the risk on a new piece of gear that might end up a "repair-shop queen" all for the want of a few shiny buttons and displays?

The solution, then, is to retrofit a digital display onto your existing equipment. By keeping your existing unit, you don't have to learn the "ins and outs" of a new arrangement of controls. One less piece of otherwise perfectly good piece of equipment stays out of the landfills, and the cost of adding new functionality instead of buying an entire new rig has no comparison—especially where your bank account is concerned!

The Digital-Frequency Displays presented here are miniature frequency counters with a difference. They feature an adjustable offset that can add to, or subtract from, the measured frequency. As such, they can display the RF frequency of superheterodyne receivers and transmitters. If the offset is set to zero, they can be used with direct-conversion receivers or as bench-top frequency counters.

Rather than try to incorporate all of the features that would be necessary to make a universal model, a "family" of displays was created. That helped to keep down the size, cost, and power supply requirements. All versions have the same physical size and shape, as well as many common circuit elements, but differ considerably in application and functionality. Of the four types of displays, only two will be described in detail; the other units are more specialized in their application and although some may find them useful, will be of limited interest.

Measuring Frequency with A PIC Microcontroller. All frequency counters work by counting the number of input cycles for a specified period of time. If the time period were one second, the result would be displayed as cycles per second.

A PIC microcontroller has a timer that can be clocked by an external signal. The internal timer is an 8-bit register that can handle a frequency that is no more than one-fourth of the chip's oscillator frequency. Since all of the Digital-Frequency Displays use a 16-MHz crystal to drive the PIC chip, the timer can only handle up to a 4-MHz signal. Beyond that limit, an internal prescaler can be used to divide down the input frequency so that it is less than the 4-MHz limit. Although the PIC software sets the prescaler to divide by 256, the maximum input frequency that the prescaler can handle is 50 MHz; to go beyond that, an external prescaler will need to be added.

A disadvantage of the prescaler circuit in this application is that the software cannot read its value. Fortunately, we can "trick" the prescaler into revealing its contents. After the measurement period is over, the software increments the prescaler until it overflows, increasing the counter register; some external hardware is needed and will be discussed later. By counting the number of times needed to make that happen, we can easily figure out what its value was at the end of the measurement period. Actually, the Digital-Frequency Displays use a 24-bit counting scheme rather than the 16-bit system formed by the 8-bit counter and 8-bit prescaler. The additional 8 bits is a PIC register that is incremented every time that the counter register overflows.

The measurement period is set by a software loop that is designed

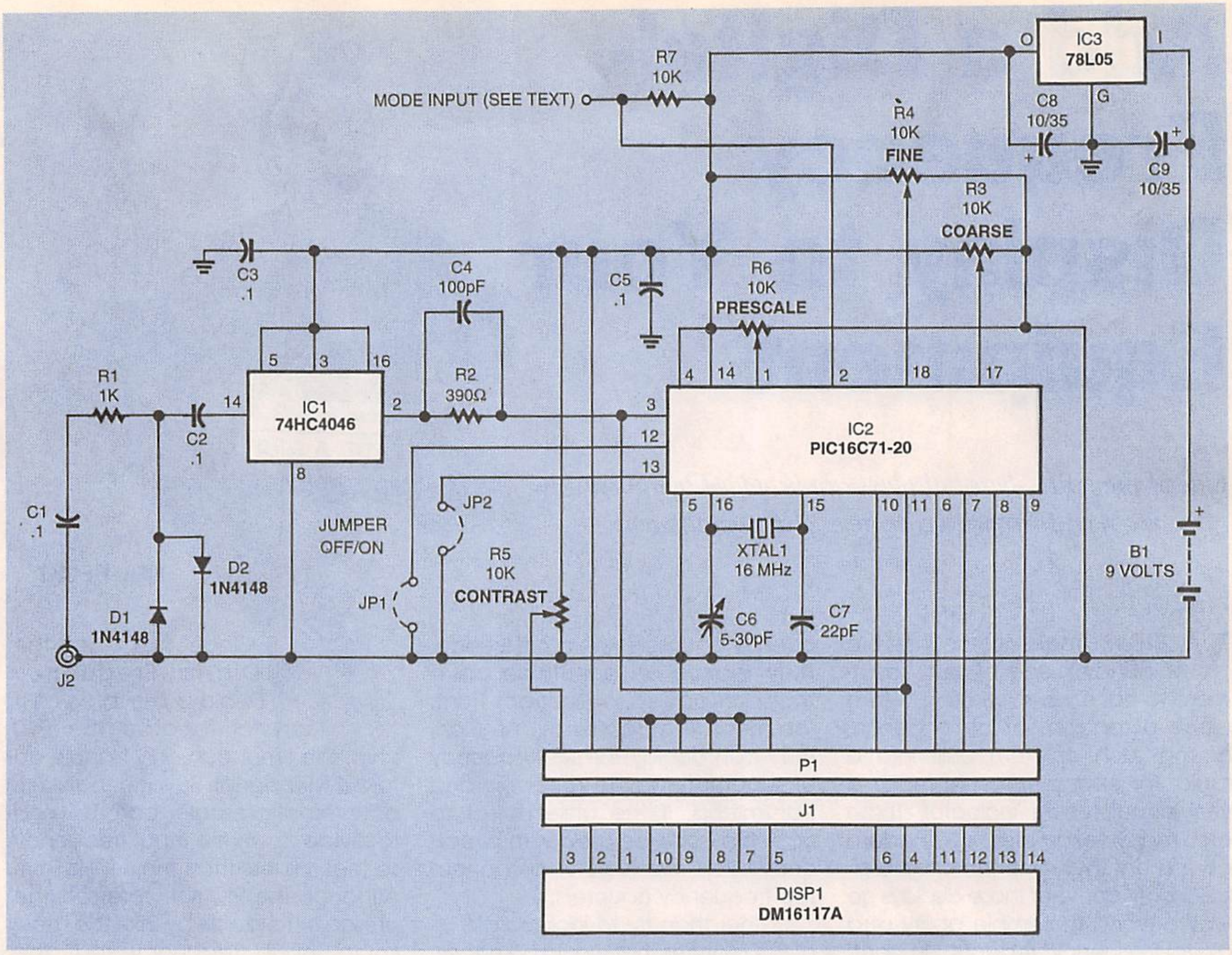


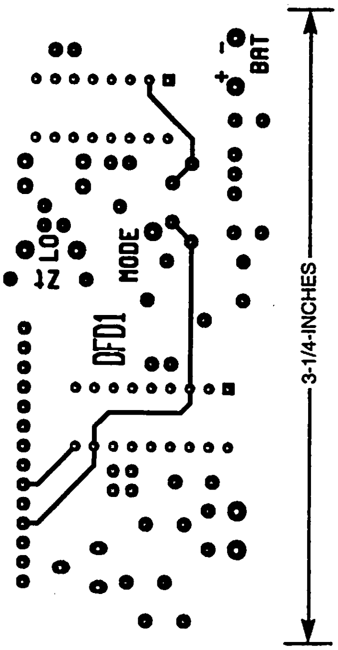
Fig. 1. A digital-frequency display such as the DFD1 shown here can be easily added to an existing piece of gear. By using a portion of IC1's phase-detection circuitry, frequencies up to 45 MHz can be displayed.

to execute an exact number of CPU cycles. While the vast majority of instructions in a PIC microcontroller are executed in one cycle, there are some two-cycle instructions such as conditional jumps that must be taken into account.

Most frequency counters have a "flicker" in the displayed value due to round-off error. That is caused by the fact that the input frequency is usually not an exact whole number. For example, let's measure a 10.6-Hz signal with a sample period of one second and a resolution of 1 Hz. The display will be 11 for 60% of the time and 10 for 40% of the time. The resulting display will then flicker between 10 and 11. A more annoying situation is with a frequency of 99.6 Hz. In that case, the display would flicker between 99 and 100. All of the Digital-Frequency Displays (with one exception) use a digital-filtering algorithm in their software to eliminate that type of flicker. In general, the technique consists of doubling the sample period, subtracting the current count from the previous count, and only changing the display if the count change is greater than one. The penalty is that the display is updated at only half the rate that would normally occur. For a frequency resolution of 10 Hz, the update rate is approximately 5 times per second—close enough to real time. In that case, the counter has 5-Hz resolution but only displays changes of 10 Hz or more.

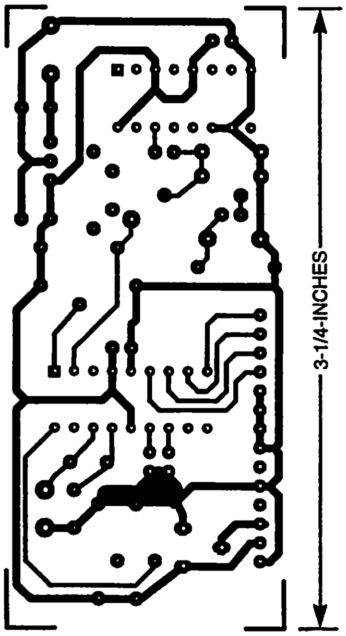
A Low-End Display. The first version that we'll describe is called the DFD1; its schematic diagram is shown in Fig. 1. The DFD1 is intended for single-conversion superheterodyne receivers and transmitters. By setting an offset value into the unit the carrier wave can be read out by measuring the IF frequency. With the offset value set to zero the DFD1 can be used with direct-conversion radios or as a bench-top frequency counter usable to 45 MHz.

A signal applied to J2 is conditioned by IC1, a 4046 phase-locked loop chip. The presence of the 4046 might appear strange in a frequency-counting circuit, but it is always fun to use a chip for something other that its original purpose! The 4046 contains an input amplifier on pin 14 that converts a low-level RF signal to CMOS voltage levels. The amplifier is connected to each of the three on-board phase detectors. One of those phase detectors is an EXCLUSIVE-OR gate. If the gate's other input (pin 3) is held at logic high, the output is a CMOS level squarewave. Since the oscillator is not used, pin 5 is held high so that



Here's the foil pattern for the component side of the DFD1. Since it is double-sided, you will need to provide some way to connect the traces on both sides of the board.

any possible interference is eliminated; power consumption is also reduced. With the addition of coupling capacitor C2 on the input and decoupling capacitor C3 on the power supply, the 4046 does an excellent job of amplifying and squaring RF signals up to 45 MHz.



Here's the foil pattern for the solder side of the DFD1.

The input is protected from transients with R1, D1, and D2. The output of IC1 is fed to the counter input (pin 3) of IC2 through R2. Note that that pin on IC2 is also connected to DISP1 and pin 11 of IC2; more on that later.

As mentioned above, the Digital-Frequency Display can add or subtract an offset value from the read frequency. Both coarse and fine offset inputs are used. The actual controls are 15-turn trimpots that are wired as voltage dividers. When IC2's analog-digital converters digitize the voltage, the trimpots act like 128-position switches. In the DFD1, R3 and R4 create a 14-bit offset that is multiplied by a constant and used as the offset. The advantages of using trimpots are low cost, ease of adjustment, high resolution, and the ability to remember their settings without power.

An additional prescale input is set by R6. That input is meant to compensate for any external prescalers that might be between the signal and the DFD1. The software reads R6 as a value between 1 and 256 and multiplies it by the frequency value. Keep in mind that that prescale adjustment is done completely in software after measuring the frequency of the input signal; it is not connected with the prescale register in IC2's hardware. An example of the use of the prescale adjustment will be given later in this article.

A fourth analog input has no control connected to it; it is labeled "mode" on the schematic diagram. The mode input is not necessary for using the DFD1; it is provided simply for displaying a series of abbreviations on the display to indicate what type of signal is being measured. The particular abbreviation is selected by connecting a resistor between the mode input and ground. One example of its use would be in a radio that has a mode switch. By selecting a series of resistors that can be grounded by that switch, the DFD1 can indicate what mode the radio is in. The different mode abbreviations that can be displayed are shown in Table 1 along with the resistor value needed to activate them. If you do not need that feature, simply leave the input unconnected, and no mode abbreviation will appear on the display.

PARTS LISTS FOR THE DFD1

SEMICONDUCTORS

IC1—74HC4046 phase-locked loop, integrated circuit
IC2—PIC16C71-20 microcontroller, integrated circuit
IC3—78L05 5-volt regulator, integrated circuit
D1, D2—1N4148 silicon diode

Resistors

(All resistors are 1/4-watt, 5% units unless otherwise noted.)
R1—1000-ohm
R2—390-ohm
R3, R4, R6—10,000-ohm potentiometer, PC-mount, 15-turn
R5—10,000-ohm potentiometer, PC-mount, single-turn
R7—10,000-ohm

CAPACITORS

C1–C3, C5—0.1-µF, ceramic-disc
C4—100-pF, ceramic-disc
C6—5-30-pF, ceramic trimmer
C7—22-pF, ceramic-disc
C8, C9—10-µF, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

B1—9-volt battery
DISP1—16-character liquid-crystal display, Optrex DM16117A or similar
J1—14-pin single in-line connector, PC mount
J2—BNC or other suitable connector
JP1, JP2—2-pin jumper post
P1—14-pin single in-line square-post header, PC mount
XTAL1—16-MHz crystal
Jumper blocks, wire, hardware, etc.

An "intelligent" liquid-crystal display (LCD) is used for DISP1. The unit specified for the Digital-Frequency Displays is available as either a standard unit or one with a backlight for use in low-light conditions. Additional circuitry will be needed for the backlight option, which is beyond the scope of this article. If you are interested in such an option, you should follow the information provided in the manufac-

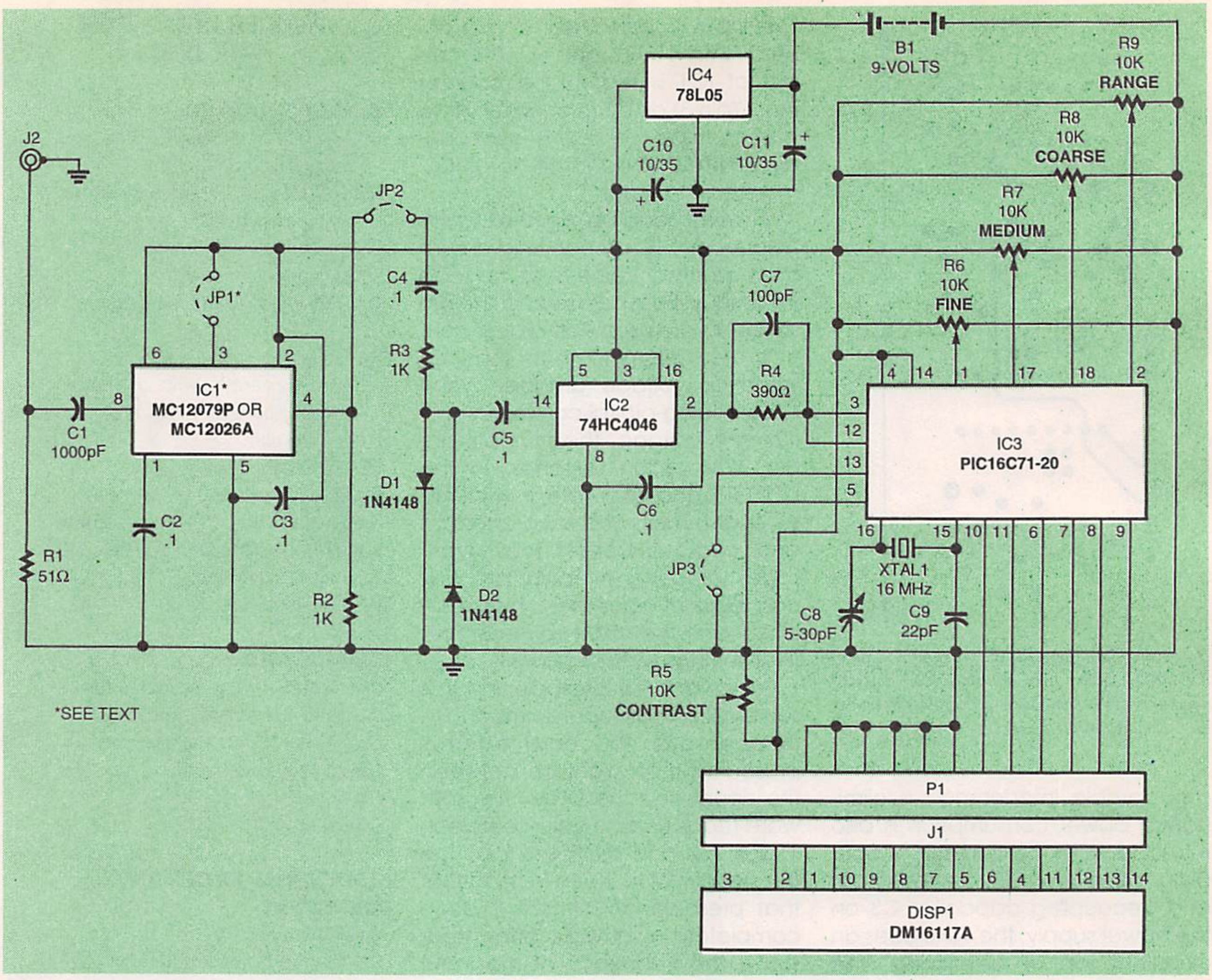


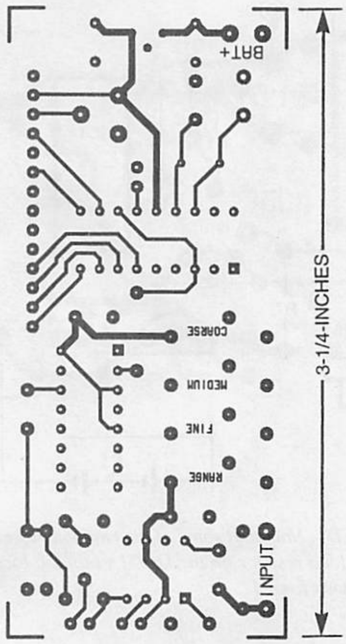
Fig. 2. Like the DFD1, the DFD4 can be used in equipment such as frequency generators and radios; it can also be used as a stand-alone unit. With the addition of a prescaler on the input, frequencies up to 3 GHz can be handled.

turer's data sheet for the display module. Such displays are called "intelligent" because they appear to a microcomputer system as just another set of storage registers. The characters to be displayed are simply loaded into the display unit, and its on-board circuitry handles the complexities of controlling a liquid-crystal display panel. These devices can be operated either with an 8-bit or a 4-bit interface. The 4-bit mode is used with the Digital-Frequency Displays to limit the number of pins needed to connect the microcontroller to the LCD unit.

The LCDs are also bi-directional; that is, you can read data from the unit as well as write data to it. To keep the number of pins needed for the interface down, the Digital-Frequency Displays never read from the LCD; the read/write control line is grounded to keep the LCD in write mode all of the time. Usually, you would read the status register of the LCD to see if it is busy before writing new display data or a command. The Digital-Frequency Displays simply wait an appropriate amount of time before writing to the LCD again, giving it time to "digest" the previous information that was sent to it. The number of interface pins needed is six: four data lines and two control lines.

There are two versions of 16-character-by-1-line LCDs available on the market; they are not software compatible. The first type stores the 16 characters as a single row; that is, the characters are stored in 16 contiguous memory locations that can be accessed completely at random. That type of display has two ICs on it. The second type, with only one chip on the back, is logically organized as two lines of eight characters. Even though the display looks like a single line of 16 characters, the memory is set up as two separate halves. To access the display data, you must first send a command selecting which "row" you want to write to. It is that second type of LCD that is used here.

We noted before that pin 3 of IC2 is connected to R2, pin 11 of IC1, and DISP1. While the main use of pin 11 of IC2 is as a register-select control for DISP1, it can be set as either an output line or an input line. When IC2 is counting the input frequency from IC1, pin 11 is set as a high-impedance input; IC1 can then pass the frequency signal through R2 to pin 3 of IC2, incrementing the prescaler and counter



Here's the foil pattern for the component side of the DFD4. While the two versions of the DFD are based on similar circuitry, the layouts are very different. Check that you have the correct patterns before etching your own board.

PARTS LISTS FOR THE DFD4

SEMICONDUCTORS

IC1—MC12079P or MC12026A prescaler, integrated circuit (see text)
IC2—74HC4046 phase-locked loop, integrated circuit
IC3—PIC16C71-20 microcontroller, integrated circuit
IC4—78L05 5-volt regulator, integrated circuit
D1, D2—1N4148 silicon diode

RESISTORS

(All resistors are ¼-watt, 5% units unless otherwise noted.)
R1—51-ohm
R2, R3—1000-ohm
R4—390-ohm
R5—10,000-ohm potentiometer, PC-mount, single-turn
R6–R9—10,000-ohm potentiometer, PC-mount, 15-turn

CAPACITORS

C1—1000-pF, ceramic-disc
C2–C6—0.1-µF, ceramic-disc
C7—100-pF, ceramic-disc
C8—5-30-pF, ceramic trimmer
C9—22-pF, ceramic-disc
C10, C11—10-µF, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

B1—9-volt battery
DISP1—16-character liquid-crystal display, Optrex DM16117A or similar
J1—14-pin single in-line connector, PC mount
J2—BNC or other suitable connector
JP1–JP3—2-pin jumper post
P1—14-pin single in-line square-post header, PC mount
XTAL1—16-MHz crystal
Jumper blocks, wire, hardware, etc.

Note: The following items are available from: Almost All Digital Electronics, 1412 Elm St. SE, Auburn, WA 98092; Tel: 253-351-9316 (9 AM to 9 PM Pacific time); Fax: 253-931-1940; E-mail: neil@aade.com; Web: www.aade.com: Complete kit of all parts for DFD1 including etched PC board, DISP1, programmed PIC controller, and all electronic components, $49.95; Complete kit of parts for DFD4 including etched PC board, DISP1, programmed PIC controller, and all electronic components, $59.95; Partial kit consisting of etched PC board, XTAL1, and programmed PIC controller, $29.95 for either version; Aluminum enclosure with black plastic bezel, $15.95; PC board alone for either unit, $4.00. To upgrade DISP1 to a backlit unit on any complete kit, please add $10.00. Please add $1.50 for shipping and handling. WA residents must add appropriate sales tax. Copies of the instruction manual for any version DFD is available by sending a self-addressed No. 10 envelope with two stamps postage to the above address.

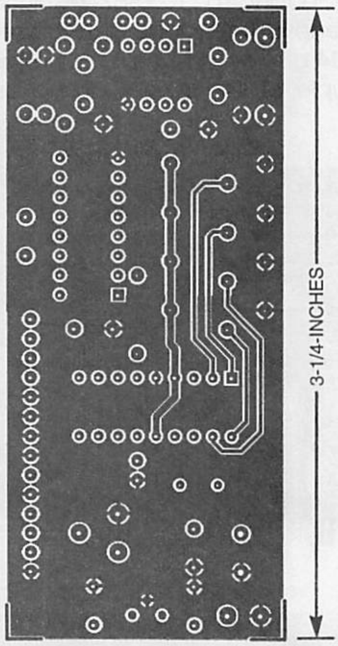
registers. When the measurement period is over, pin 11 on IC2 is set to be an output, clamping pin 3 of IC2. The result is that IC2's counter no longer sees any pulses, freezing the count. By toggling pin 11, the prescaler is incremented until it overflows into the counter register; that is how the prescaler register is read as discussed before. Having C4 in parallel with R2 provides frequency compensation.

Note that all of that activity on DISP1's register-select line has no effect on the display; all data and control lines are ignored unless DISP1's enable line is activated by pin 10 of IC2. To round out the discussion of the circuitry surrounding DISP1, the contrast of the display is adjusted by R5.

Jumpers JP1 and JP2 set two additional options for the DFD1. The first one selects whether the display will have a 10-Hz or 100-Hz resolution; if a jumper is installed, shorting the connection, a 100-Hz resolution will be in effect. The second jumper selects whether to add (no jumper) or subtract (jumper installed) the offset value from the frequency.

Some might be wondering why someone would "cripple" a high-performance unit such as the DFD1 by forcing it down to a 100-Hz resolution. The reason for that has to do with the variable-frequency oscillators (VFOs) of some older radios. Those older circuits many times do not have sufficient short-term stability. With a 10-Hz resolution on the DFD1, the last digit might change continuously. If that happens, the 100-Hz option gives a more stable display.

The DFD1 regulates and filters the power supply voltage with IC3, C8, and C9. Although a 9-volt battery is shown for B1, any source of filtered DC can be used to power the



Here's the foil pattern for the solder side of the DFD4.

DFD1. For example, a convenient power source in the equipment in which you will be mounting the DFD1 can be used as long as it is a filtered DC source between 8 and 18 volts.

A High-End Display. The other Digital-Frequency Display that will be discussed is called the DFD4; its schematic diagram is shown in Fig. 2. If you compare the schematic diagrams of the DFD4 to the DFD1, you'll see that the two units are very similar. The main difference is the addition of prescaler chip IC1. With the use of IC1, the DFD4 can be used in UHF applications that need to read frequencies up to 3 GHz. Although IC1's specification sheet only guarantees operation up to 2.8 GHz, the manufacturer claims that 3-GHz operation and higher is easily achieved. However, be advised that operation at those frequencies might become a bit difficult. Careful connection of the input frequency with suitable coaxial cable becomes mandatory for proper operation.

Although IC1 sports a programmable divide-ratio feature, it is permanently set to divide by 128 in the DFD4 circuit. Also keep in mind that a socket is not recommended for frequencies above 1 GHz. However, testing of the author's prototype yielded very reliable operation when using a socket at frequencies up to 540 MHz—the limit of the available test equipment.

If you do not need the full 3-GHz capability of the DFD4, IC1 can be substituted with an alternate prescaler mentioned in the Parts List. The circuit will then be limited to 400 MHz—perfectly suitable for VHF applications. When using the lower-frequency prescaler, JP1 will need to be installed. The substitute prescaler, with its higher dividing ratio, allows for resolutions of 10 Hz up to 32-MHz frequencies and 100 Hz at higher frequencies; the display will be updated at near real-time rates. It also allows the inclusion of digital filtering to eliminate round-off flicker—a feature that cannot be used in the full-blown 3-GHz model.

Jumper JP2 is used to connect the output of IC1 to the input of IC2. Normally, the two circuits would be connected; without the connection, no input can get to IC3 or the input would be applied to IC2, making the DFD4 a copy of the DFD1. The purpose of JP2 is to provide just that type of access to the input of IC2. That would be done when using the DFD4 as a benchtop frequency counter; more on how to do that later.

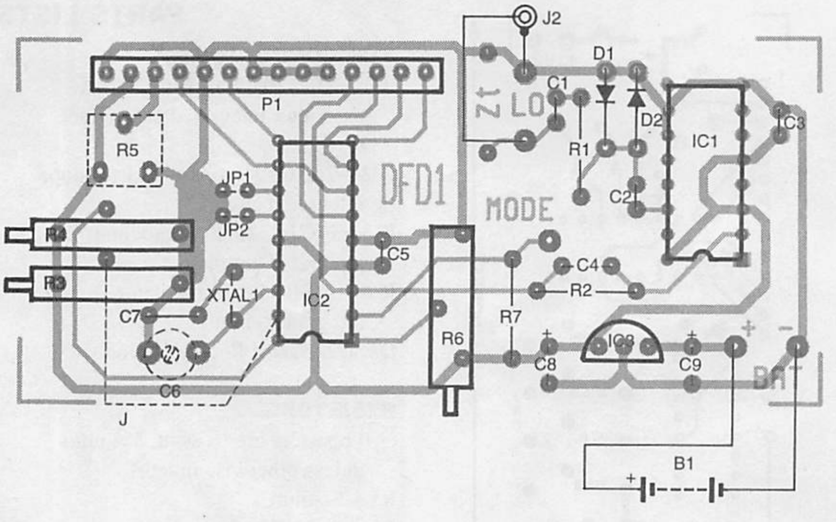


Fig. 3. Here's the parts-placement diagram for the DFD1. Note that some of the components mount on the solder side of the board. If you need to have a load resistor on the DFD1's input, a location has been provided just to the left of the input connections from J2.

Whereas the DFD1 used two trimpots for setting the offset value, the DFD4 uses three—R1, R2, and R3. The result is a 21-bit number. That number is multiplied by 1000 (1 kHz) for an offset range from 0 to 2,097,152,000 Hz. Like the DFD1, the DFD4's offset can be added to or subtracted from the measured frequency by setting JP3.

A fourth analog input provided by R4 sets the DFD4 to one of four operating ranges: the "HF SLOW" range from 0–32 MHz with a 1-second sample period and a 1-Hz resolution; the "HF FAST" range from 0–32 MHz with a 0.1-second sample period and a 10-Hz resolution; the "UHF SLOW" range from 10–3000 MHz with a 1.28-second sample period and a 100-Hz resolution; and the "UHF FAST" range from 10-3000 MHz with a 0.128-second sample period and a 1000-Hz resolution. Whenever the range changes, the DFD4 displays the new range for a couple of seconds; that makes it

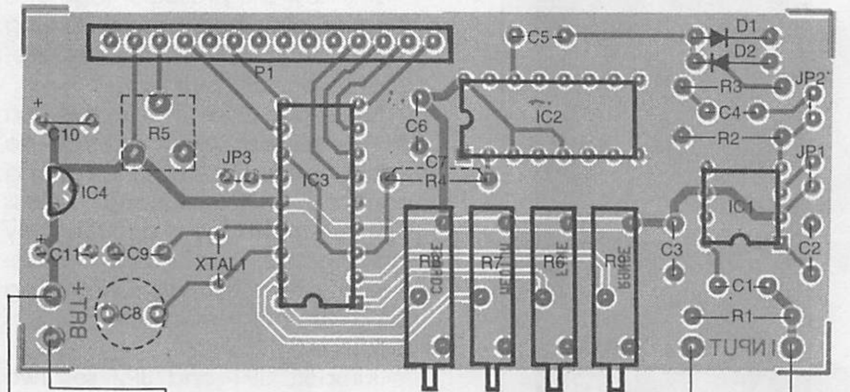


Fig. 4. The DFD4 is similar in construction to the DFD1. Again, note that some of the components mount on the solder side of the board. Those parts need to be accessible for settings and adjustments with DISP1 in place.

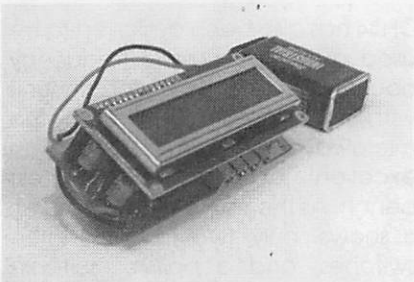


Fig. 5. The completed DFD4 is a compact unit. Note how the PC board "piggybacks" onto DISP1.

easy to set the range with a trimpot.

Construction. Because of the high frequencies involved, the Digital-Frequency Displays should be built on a PC board. Double-sided boards are used for a compact unit; foil patterns have been included for both versions. If you are going to etch your own board, you should be sure to solder connections on both sides of the board. Boards that are purchased from the source given in the Parts List have plated-through holes.

The parts-placement diagram for the DFD1 is shown in Fig. 3; follow Fig. 4 if you are building the DFD4. Since both units are very similar, construction details apply to both units.

Note that some components mount on the solder side of the board. Those parts will need to be accessed with the unit assembled. Items such as the jumper blocks and DISP1's contrast control would otherwise be inaccessible once DISP1 is mounted in place.

Start by mounting XTAL1. It should be mounted off of the board so that its metal can does not touch the traces on the topside of the board. Use either a flat toothpick or a piece of insulated wire to space the crystal off of the board while soldering it. Once soldered, remove the spacer; an easy task to perform as XTAL1 is the only component on the board!

The microcontrollers will need to be programmed before installing them. Download the appropriate code from the Gernsback FTP site (ftp.gernsback.com/pub/EN). The names of the files are dfd1.hex and dfd4.hex for each version, respectively. When programming the PIC, note that your programmer should be set to program the PIC for an HS-XTAL oscillator, the Watchdog Timer disabled, and the Power-Up Timer enabled.

Continue by mounting the rest of the topside components, starting with the smallest physical packages such as the resistors and diodes. Sockets can be used for the ICs, with the exception of the 3-GHz version of IC1 on the DFD4 as discussed before. Note that on the DFD4, C7 will be tack-soldered on the bottom side of the board after R7 is installed so that both components are wired in parallel. Alternatively, wrap the leads of C7 around R4's leads and solder all joints after installing the R4/C7 combination in the board.

Once all of the topside components have been mounted, continue with the bottom-side components; all of their connections are accessible from the topside of the board. Finally, the DFD1 needs a jumper wire tack-soldered to the indicated points. Mounting J1 onto DISP1 completes assembly. With J1 mated to P1, the completed Digital-Frequency Display forms a compact package. After checking your workmanship for defective solder joints or incorrect component placement, look it over again. Better yet, set it aside for a while and re-inspect it after you've had a bit of a rest. Many seemingly obvious mistakes can be easily overlooked if you are constantly staring at them.

A completed DFD4 is shown in Fig. 5. It is now ready for installation in the equipment of your choice.

Installing the DFD. Obviously we can't give detailed installation instructions for each and every possible piece of equipment, so some general recommendations will have to suffice.

For starters, a suitable hole will have to be cut in the unit's case to hold the Digital-Frequency Display. Detach DISP1 from the unit and mount it to your equipment. Once mounted, it is easy to plug P1 into J1 once the Digital-Frequency Display is wired up to power and signal inputs.

If you are mounting the DFD in a radio, for example, the input at J2 (which can be eliminated in favor of a direct connection) is connected to the variable-frequency oscillator (VFO) of the radio. That connection should be made at a low-impedance point, such as the unbypassed cathode of a vacuum-tube oscillator or the unbypassed emitter of a transistor oscillator; use the schematic diagram of your radio to pinpoint that location. It should also be isolated from the tank circuit of the oscillator to

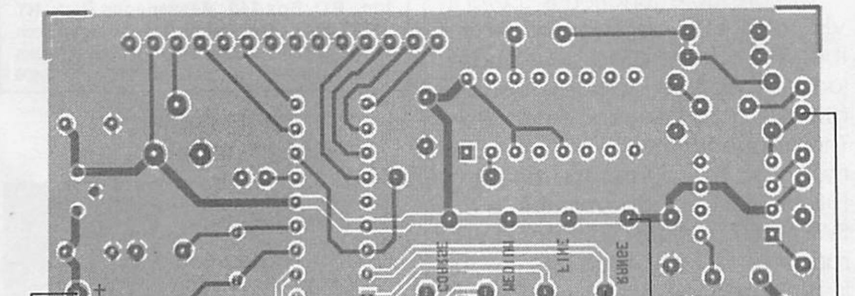


Fig. 6. By replacing R9 with this simple circuit, the DFD4 can be used as a stand-alone frequency counter capable of 3 GHz. Battery power means that the unit is portable and easy to use in the field.

prevent the input capacitance of the DFD from affecting the frequency of the oscillator. If an amplifier exists between the oscillator and the mixer, the connection should be made at the output of the amplifier. In general, the best point is at the input to the mixer.

Because of the amplitude-limiting effect of D1 and D2, the level of the voltage should be scaled to prevent clipping the waveform. Using a potentiometer as a "volume control" between the signal and ground can do that. The signal should be capacitor-coupled to one side of the potentiometer with the other side connected to ground. The wiper is connected to the DFD's input. The value of the coupling capacitor should be about 100 pF for frequencies above 10 MHz and 1000 pF for frequencies below 10 MHz. The value of the potentiometer should be about 1000 ohms. Adjust the potentiometer to the minimum signal level that provides reliable operation at the highest frequency that might exist at that point.

Setting Up a DFD. Setting up a Digital-Frequency Display is simple. We'll discuss the DFD1; the DFD4 works in a similar manner. Start by shorting the input to ground; that will prevent noise from triggering the unit. Adjust R6 (prescale) to display a minimum frequency. Next, adjust R3 (coarse) and R4 (fine) to display the desired offset. If you are going to be working with a radio receiver or transmitter, the offset is usually the radio's IF frequency. If the prescale option is to be used, first set the coarse and fine offsets to the IF frequency divided by the prescale to be used, then adjust the prescale control (R6) until the display reads the IF frequency. That way, we can be sure that that the prescale setting is properly set. All of the trimpot adjustments should be left half way between the lower and upper transition points for best thermal stability.

Connect the DFD1 to the VFO of a radio. The display will show the VFO frequency with the offset either added to or subtracted from it; JP2 controls the function. By setting JP2, the DFD1 will display the correct RF frequency regardless of the relationship between the VFO, IF, and RF.

If you have a band-imaging radio, that feature can be very helpful. By connecting JP2 to the band-select switch, the DFD1 can show the correct display for both bands. If your band-imaging radio is set for the 17- and 30-meter bands with a VFO frequency range of 14 to 14.168 MHz and an IF of 4 MHz, the readout frequencies will be 18 to 18.168 MHz (JP2 off) or 10 to 10.168 MHz (JP2 on).

For the 80- and 20-meter bands with a VFO range from 5.0 to 5.5 MHz and an IF of 9 MHz, the readout frequencies will be 14.0 to 14.5 MHz and 4.0 to 3.5 MHz. In the latter case, the VFO tunes backward. Mathematically, VFO – OFFSET will be a negative number but the DFD1 is designed to display the absolute value.

The prescale function is useful in VHF and UHF applications where the VFO is generated by a phase-locked loop that includes prescaler dividers, or by frequency multipliers. The frequency of the VFO can be multiplied to counter the effect of the divider. A good example is the SWAN 250 six-meter rig. It has a VFO range of 13.1 to 14.433 MHz, which is multiplied by 3 to yield 39.3 to 43.3 MHz. The IF is 10.698 MHz. Adjust the DFD1 to the IF/3, or 3.566 MHz. Adjust R6 to display an IF of 10.698 MHz. Remove the jumper from JP2 and connect the DFD1 to the radio's VFO. The correct RF frequency will be displayed.

A Stand-Alone Frequency Counter. As versatile as the Digital-Frequency Displays are when added to an existing piece of equipment, the DFD4 has also been designed to be used as a stand-alone frequency counter. Such a high-capacity unit with its ability to work into the microwave spectrum will make an excellent addition to any test bench. As the wiring diagram in Fig. 6 shows, only two resistors, three switches, and a pair of suitable input jacks are needed. Note how a switched-resistor circuit has replaced R9. Feel free to use any style of connectors that will make the stand-alone version of the DFD4 easy to connect to other equipment.

The Digital-Frequency Displays make it easy and inexpensive to add a digital-frequency readout to almost any kind of radio or test equipment, or make an inexpensive bench-top frequency counter. No longer will guesswork need to guide you in your radio work—a simple glance at the display is all that's needed! Ω

TABLE 1

DISPLAY VALUE	RESISTOR
Blank	open (no resistor)
AM	65,000-ohm
FM	27,500-ohm
CW	15,000-ohm
USB	8750-ohm
LSB	5000-ohm
FSK	2500-ohm
FAX	short (wire jumper)

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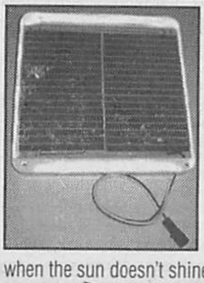

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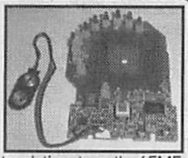

This is a complete EMF detector utilizing 3 SMD ICs and 10 bright LEDs that indicate relative strength of EMF energy. Operates on one 9V battery (not included). As soon as you press the on/off button, the unit runs a "self-test" by lighting all 10 LEDs then it resets itself and indicates the relative EMF strength by the quantity and color of LEDs that light. Size of unit is about 3 5/16" x 2 3/8". These are brand new and prime, but without the outer plastic case. Full scale is 1 milligauss. We have no data or schematics, but all you need to do is connect a 9V battery and you're in business.

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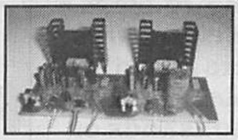

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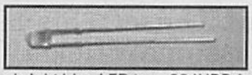

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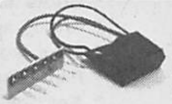

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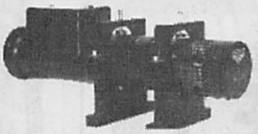

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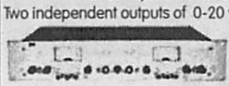

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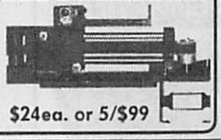

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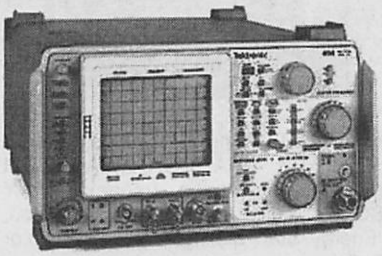

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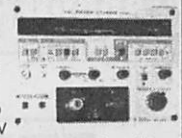

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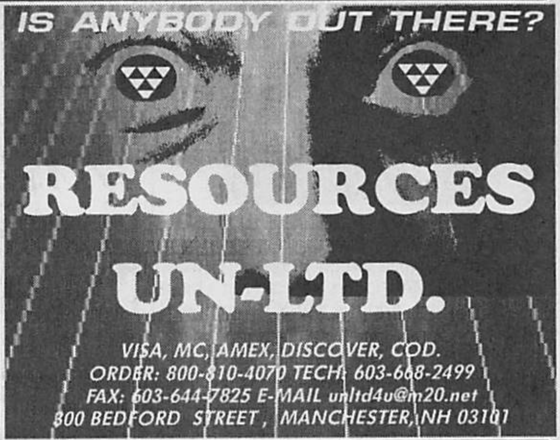

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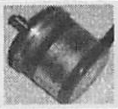

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Complete depot refurbished system incl. soft case, High gain 30K to 50K, three stage, intensifier, ABC, 95mm, 4 pwr, f1.2 "CAT" lens, 10.7° FOV, ELCAN MOUNT. Operates 40 hours on 4 AA batts., 17.5"L x 3.5"D, 7.7" **Special....$649**

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Varible load control knob and exclusive split ball feature have a range of tension which permits moving work to any position. A slight additional turn locks the head firmly if place. Only 3 1/2" high. Designed for working close to thebench surface. 4" square mounting base for permanent attachment to surface. Steel with Grey color **Pana400....$10**

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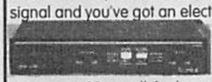

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Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <1ounce! IR SENSITIVE. 23mmdX50mm, 36" cable with BNC video & DC barrel jack. PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 once! Size only 23mm d.x35mm long. Think of the places you could put this little jewel.

SPECIAL. $99ea., GM-200K-STD or PINHOLE lens

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For those applications that must be color, this is it. Black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 400 Lines resolution, <1 Lux sensitivity, AGC, Auto Shutter. 12VDC @180mA, 4.3mm, 78° FOV lens, A real glass lens. Std. video out. Size: 32mm diam. X 65mm long. 24" leads with RCA jack and DC jack. Ready to go! with power adapter.

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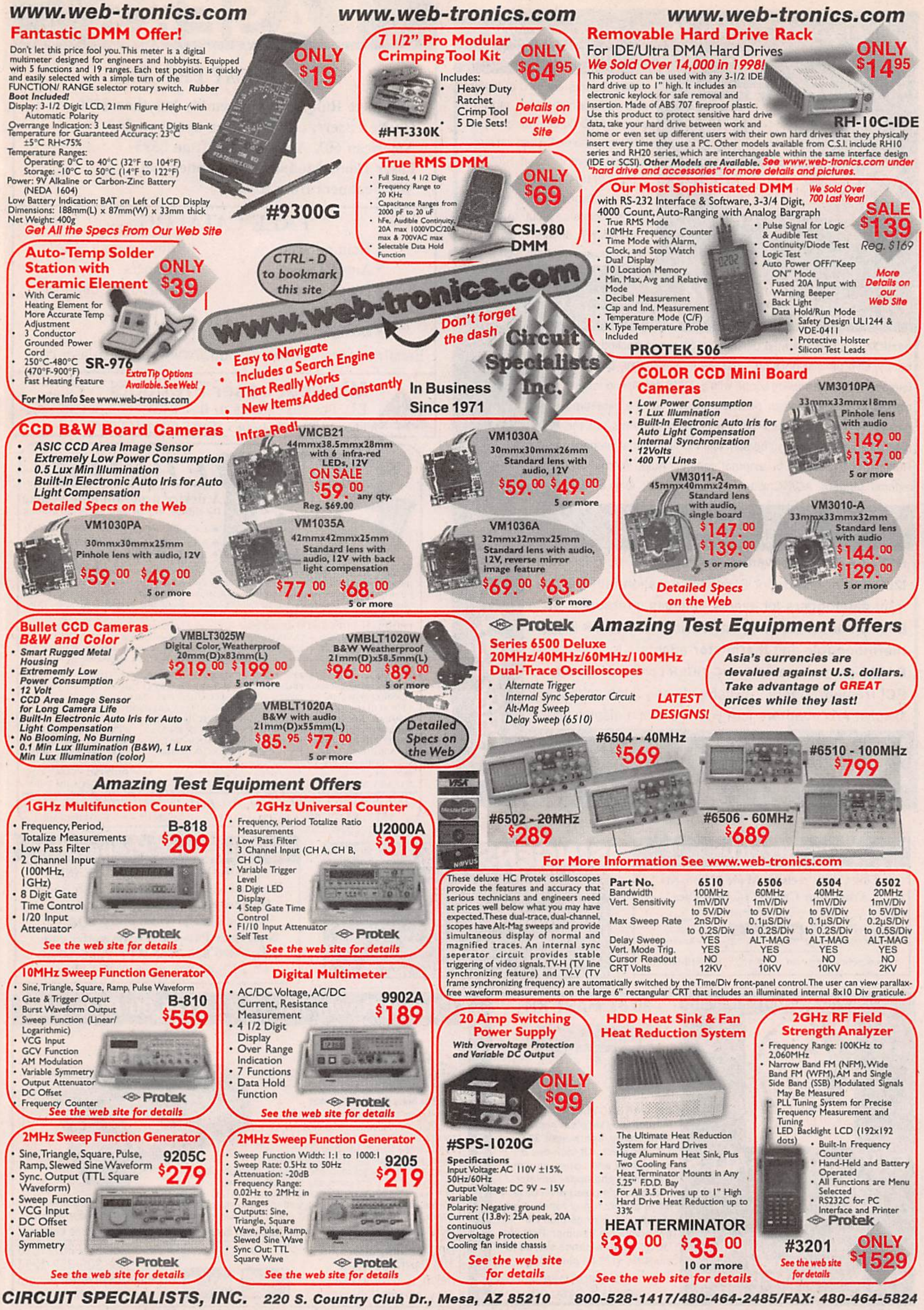
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Part No. | 6510 | 6506 | 6504 | 6502
Bandwidth | 100MHz | 60MHz | 40MHz | 20MHz
Vert. Sensitivity | 1mV/DIV to 5V/Div | 1mV/Div to 5V/Div | 1mV/Div to 5V/Div | 1mV/Div to 5V/Div
Max Sweep Rate | 2nS/Div to 0.2S/Div | 0.1µS/Div to 0.2S/Div | 0.1µS/Div to 0.2S/Div | 0.2µS/Div to 0.5S/Div
Delay Sweep | YES | ALT-MAG | ALT-MAG | ALT-MAG
Vert. Mode Trig. | YES | YES | YES | YES
Cursor Readout | NO | NO | NO | NO
CRT Volts | 12KV | 10KV | 10KV | 2KV
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B-818 $209
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• Sync. Output (TTL Square Waveform)
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• DC Offset
• Variable Symmetry
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• Sweep Rate: 0.5Hz to 50Hz
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• Frequency Range: 0.02Hz to 2MHz in 7 Ranges
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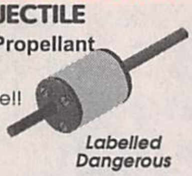

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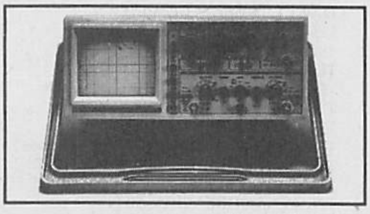

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DMM-20 ($74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle
DMM-122 ($59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity
DMM-123 ($44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity
DMM-10 ($19.95): 3½ digit, DC/AC V, Ω, hFE, diode, signal output(+3V,-0.5Vsq.,50%duty)

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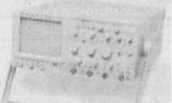

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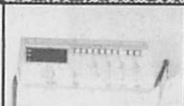

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CIRCLE 236 ON FREE INFORMATION CARD

USE ELECTRONICS NOW CLASSIFIEDS

READ BY ELECTRONIC BUYERS AND SELLERS AND TRADERS

INSTRUCTIONS FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $2.50 per word. Minimum charge is $37.50 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Boldface (not available as all caps)**, add .40 per word additional. **Entire ad in boldface**, add 20%. **Tint screen behind entire ad**, add 25%. **Tint screen plus all boldface ad**, add 45%. **Expanded type ad**, add $4.00 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. ELECTRONICS NOW is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in ELECTRONICS NOW is limited to electronics items only. All ads are subject to the publishers' approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

AD RATES: $2.50 per word, Minimum $37.50

Send you ad payments to:
ELECTRONICS NOW 500 Bi-County Blvd, Farmingdale, NY 11735-3931

CATEGORIES

100 – Antique Electronics	270 – Computer Equipment Wanted	450 – Ham Gear Wanted	630 – Repairs-Services
130 – Audio-Video Lasers	300 – Computer Hardware	480 – Miscellaneous Electronics For Sale	660 – Satellite Equipment
160 – Business Opportunities	330 – Computer Software	510 – Miscellaneous Electronics Wanted	690 – Security
190 – Cable TV	360 – Education	540 – Music & Accessories	710 – Telephone
210 – CB-Scanners	390 – FAX	570 – Plans-Kits-Schematics	720 – Test Equipment
240 – Components	420 – Ham Gear For Sale	600 – Publications	730 – Wanted

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9 - $37.50	10 - $37.50	11 - $37.50	12 - $37.50
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17 - $42.50	18 - $45.00	19 - $ 47.50	20 - $50.00
21 - $52.50	22 - $55.00	23 - $57.50	24 - $60.00
25 - $ 62.50	26 - $65.00	27 - $67.50	28 - $70.00
29 - $72.50	30 - $75.00	31 - $77.50	32 - $80.00
33 - $82.50	34 - $85.00	35 - $87.50	36 - $90.00
37 - $92.50	38 - $95.00	39 - $97.50	40- $100.00

Total words________ $2.50 per word = $______

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TOTAL COST OF AD $ ________

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Signature____________________________

Name ____________________________ Phone ____________________________

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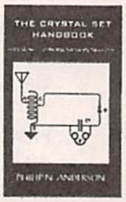

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California Electronics
221 N. Johnson Ave.
El Cajon, CA 90202

Ford Electronics
8431 Commonwealth Ave
Buena Park, CA 90621

All Electronics
14928 Oxnard Street
Van Nuys, CA 91411

San Mateo Elec. Supply
16 W. 42nd Ave.
San Mateo, CA 94403

Electronics Warehouse
2691 Main Street
Riverside, CA 92501

Orvac Electronics
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Fullerton, CA 92631

Sav-On Electronics
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Garden Grove, CA 92643

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Westminster, CA 92683

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San Rafael, CA 94901

Minute Man Electronics
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Fremont, CA 94536

HCS Electronics
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Cotati, CA 94931

Halted Specialties Co.
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Santa Clara, CA 95051

Metro Electronics
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Sacramento, CA 95814

HSC Electronics
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Sacramento, CA 95841

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Colorado Sps., CO 80909

Connecticut

Cables & Connectors
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Newington, CT 06111

Electronic Service Prod.
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North Haven, CT 06473

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Wholesale Electronics
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New Castle, DE 19720

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Berwyn, IL 60402

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Add a Phono Adapter to your Home Stereo

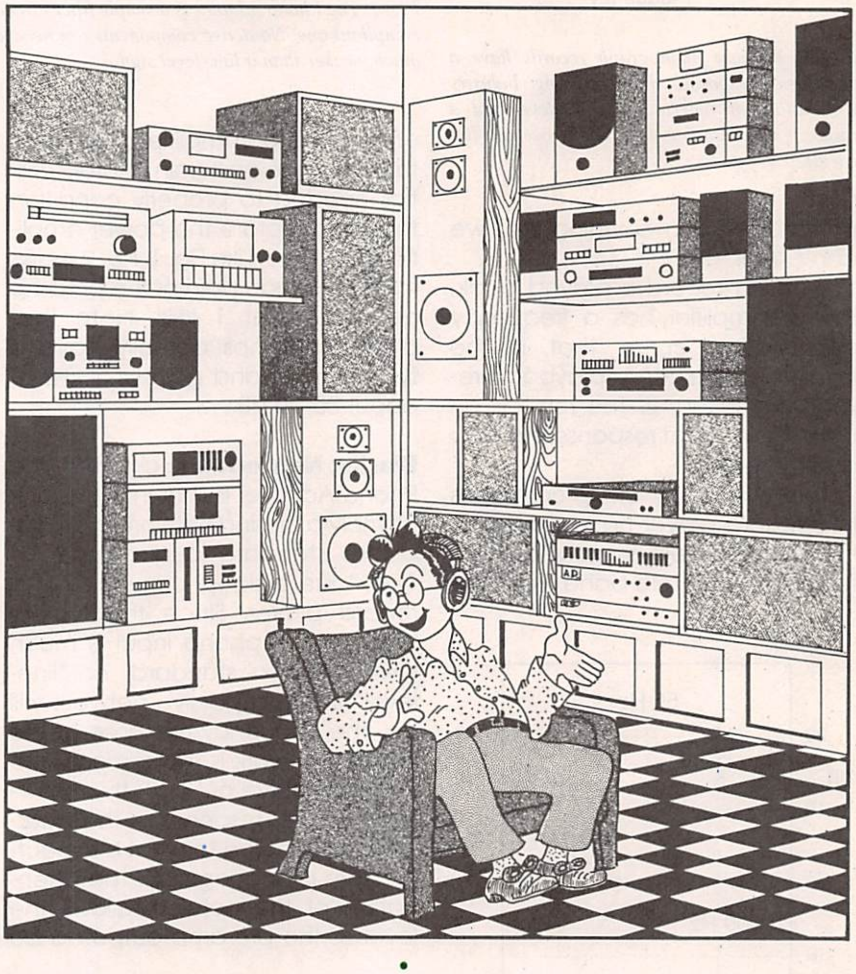
Reclaim that unused phonograph input on your amplifier with this simple adapter.

JOE GUSTAINIS

Although the era of the phonograph record has been over for more than a decade, stereo receivers and amplifiers still have phonograph inputs. Unless you have an extensive collection of "black vinyl" and still enjoy listening to them, the phono input on your home stereo is probably just sitting there unused.

On the other hand, you probably have a large collection of audio gear from CD and DVD players to cassette decks and component television. The audio outputs of those units are all fighting for an input to your amplifier, yet there is that phonograph input, sitting there unused. If there were a way to use that input with a modern piece of audio gear, the pressure to find jacks for everything in your home theatre would ease off that much more.

To the rescue comes the Phono Adapter described here. This simple circuit will let you use a standard audio source with an unused phono input. With the Phono Adapter plugged in between a piece of audio gear and the phono input of an amplifier, an additional auxiliary input for your sound system is gained. Electronics projects such as this one don't get much easier. Not only is it the perfect project for someone that has little skill in construction, it can be completed in less than two hours at very low cost and is a project that can be used every day.



Phonograph-Record Response. The phono jacks in your receiver or amplifier are connected to a special preamplifier circuit that provides the conditioning needed to deliver a flat frequency response for the extremely non-linear, low-level frequency characteristics of a phonograph. Since phonograph equipment never provided a truly linear frequency response, the effective dynamic range and signal-to-noise ratio of records was enhanced by intentionally recording non-linearly in accordance with a standard curve defined by the Recording Industry Association of America (RIAA). Figure 1 shows the typical frequency response of a phonograph-record playback, along with its pole/zero asymptotes. The response shown is normalized to 0 dB at 1 kHz and contains a zero at 50 Hz, a pole at 500 Hz, and a zero at 2120 Hz. Additional poles occur beyond the audio range; they are not shown since we are obviously

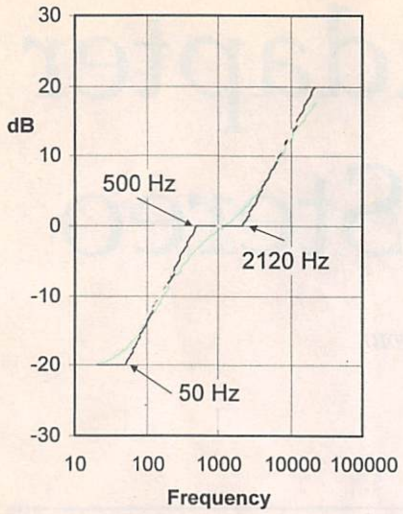


Fig. 1. Because phonograph records have a non-linear response, the Recording Industry Association of America (RIAA) developed a response standard that deals with those non-linearities.

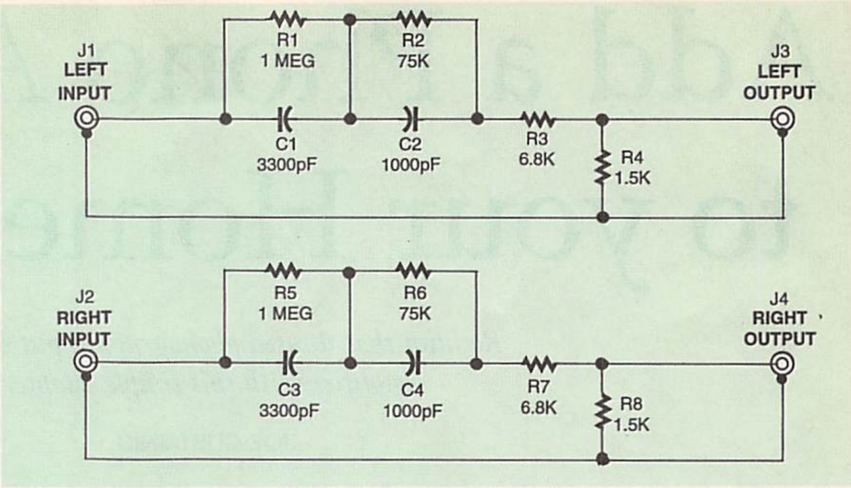


Fig. 3. The Phono Adapter is a simple filter circuit that changes a standard audio signal to an RIAA-compliant one. No active components are needed because the signal from a phonograph needle is much weaker than a line-level signal.

not interested in anything that we can't hear.

When a record is played back, the preamplifier has a frequency equalization curve that is the inverse of the RIAA playback response; see Fig. 2. The result is an output with a flat response over the audio range.

The magnetic pick-up cartridges in a record player have extremely low output levels—typically only a few millivolts at mid-band. Because of that, the preamplifier must have the low-noise and gain characteristics needed to properly condition the signal before the power amplification stage. Like Fig. 1, Fig. 2 shows the magnitude gain of the preamp normalized at 1 kHz. Note that phono preamps actually have a typical mid-band gain at 1 kHz of about 30–40 dB.

Biasing Network. The circuit for the Phono Adapter is shown in Fig. 3. It is simply a biasing network that conditions standard audio signal to "look" like a signal coming from a record player. Since the typical level for the phono input is much lower than a standard, or "line-level" input, a passive network will do. The frequency response of the biasing network is the same as the response curve of Fig. 1, thus skewing the "flat" response of the external audio source to what is expected from a phonograph. The attenuation of the network allows the level of the pre-amp output to be similar in amplitude to a standard auxiliary input; the volume of your system won't have to change when listening to a piece of audio gear though the phono input.

The network was selected to provide relatively high input impedance to accommodate a variety of audio sources. The input impedance of the network at any frequency will always be greater than the sum of R3 and R4 (R7 and R8 for the right channel). If the sum of those resistors is kept significantly higher (over ten times) than the output impedance of whatever audio source you are using, the frequency response and the scaling of the network will not be significantly affected.

Likewise, the output impedance of the network must be kept significantly lower than the input impedance of the phonograph preamplifier. The output impedance of the network will always be less than R4 (R8 in the right channel); an RIAA standard phono preamplifier has

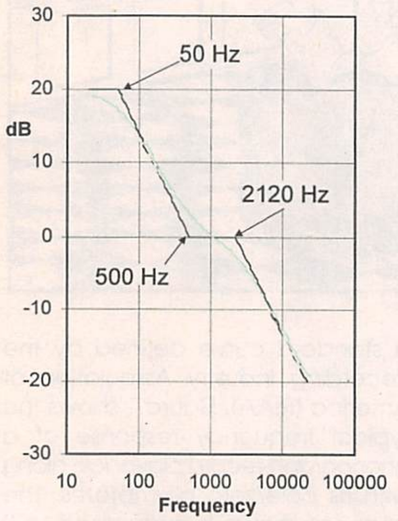


Fig. 2. An RIAA-compliant preamplifier has a frequency response that is the inverse of the RIAA curve. When an RIAA signal is played through the preamplifier, the result is a flat-frequency response.

TABLE 1
ALTERNATE COMPONENT VALUES

Component	Value	Alternate 1	Alternate 2	Alternate 3
R1, R5	1 Meg	1.2 Meg	2.2 Meg	3.3 Meg
R2, R6	75K	91K	160K	270K
R3, R7	6.8K	10K	10K	4.7K
R4, R8	1.5K	1.5K	3.3K	4.7K
C1, C3	3300 pF	2700 pF	1500 pF	1000 pF
C2, C4	1000 pF	820 pF	470 pF	270 pF

$$\frac{Vout(s)}{Vin(s)} = (0.001385)\frac{\left(\frac{s}{2\pi 50}+1\right)\left(\frac{s}{2\pi 2120}+1\right)}{\frac{s^2}{(2\pi 500)(2\pi 26555)}+\left(\frac{1}{(2\pi 500)}+\frac{1}{(2\pi 26555)}\right)s+1}$$

$$\frac{Vout(s)}{Vin(s)} = \left(\frac{R_4}{R_1+R_2+R_3+R_4}\right)\frac{\left(R_1C_1s+1\right)\left(R_2C_2s+1\right)}{\left(\frac{R_1R_2\left(R_3+R_4\right)}{R_1+R_2+R_3+R_4}C_1C_2\right)s^2+\left(\frac{R_1\left(R_2+R_3+R_4\right)C_1+R_2\left(R_1+R_3+R_4\right)C_2}{R_1+R_2+R_3+R_4}\right)s+1}$$

Fig. 4. Although the Phono Adapter circuit is very simple, the math needed to design it properly can get quite involved.

an input impedance of 47,000 ohms. Cable and input capacitance of the preamplifier can also affect the network's response. That capacitance can be on the order of 100 to 1000 pF, so it is necessary to keep the output impedance of the network less than about 4700 ohms in order not to create an additional in-band pole.

The simplicity of the Phono Adapter's circuit does an excellent job of hiding the complex mathematical equation that designed it. That equation, called a *Laplace Transform*, is shown in Fig. 4; the equivalent representation in terms of component values is included. While the zeroes at 50 Hz and 2120 Hz, and the pole at 500 Hz are required by the RIAA standard, the pole at 26,555 Hz is not. That pole can be any frequency as long as it is outside of the audio band (above 20 kHz). The 26,555-Hz pole shown is specific to our circuit.

For additional information concerning the design of RIAA circuits, see National Semiconductor's application note AN-346, titled "High-Performance Audio Applications of the LM833."

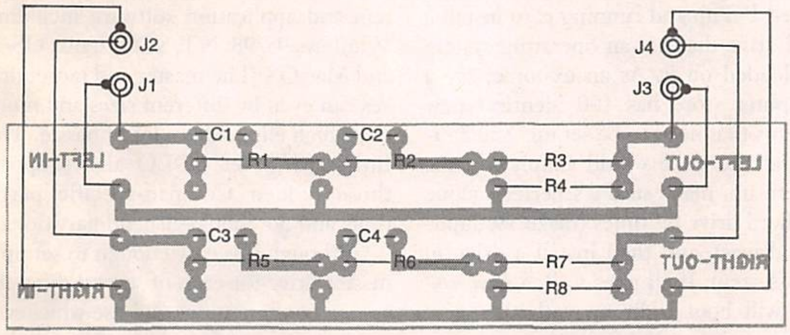
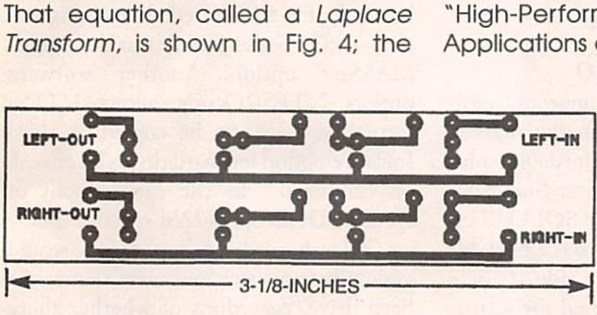


Fig. 5. If you want to build the Phono Adapter on a PC board, use this parts-placement diagram to locate the components.



Here's the foil pattern for the Phono Adapter. The circuit is simple enough to fit on a single-sided board without the need for jumpers.

Construction. As you can see from the schematic diagram, the Phono Adapter is an extremely inexpensive project. The most expensive item will be the project case itself—if you decide to use one.

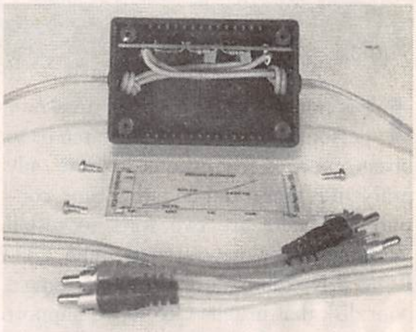


Fig. 6. The author's prototype used hard-wired cables instead of jacks. Note the overhand knots tied in the cables to act as strain reliefs.

It is not necessary to use an etched PC board; a small piece of perfboard can be used with standard construction techniques. On the other hand, a printed-circuit board makes for a neater assembly. If you'd like to use an etched board, a foil pattern has been included here; follow the parts-placement diagram shown in Fig. 5.

If you do not want to mount jacks on the case, you can substitute a dual phono-plug cable for J1–J4. Cut the cable in half and connect the inputs and outputs to the severed ends. Use vinyl grommets to protect the cables where they pass through holes in the case. Additionally, tie an overhand knot in the cable to act as a strain relief. As you can see in the photo of the au-thor's prototype (Fig. 6), the severed-phono-cable app-roach was used, as that was less expensive.

Component tolerances will effect the shaping characteristics,

(Continued on page 89)

EQUIPMENT REPORT

INTELLIGENT COMPUTER SOLUTIONS' IMAGE MASSTER SOLO

Clone hard drives and set up computers the easy way with the Image MASSter SOLO.

CIRCLE 15 ON FREE INFORMATION CARD

It is not too difficult to set up a new personal computer from scratch or to bring one back from the dead. The only problem is that it can be rather time-consuming. There are two ways to install Windows on a new system. The CD-ROM drive can be brought to life using a boot disk that installs CD-ROM support and then installing Windows from CD. Otherwise, the install directory on the CD must be copied to the hard drive, and then the operating system is installed from there. Obviously, that method will only work if your computer has CD-ROM support in BIOS. Either way, and even with the fastest of systems, installing an operating system is going to take at least a half hour or so, and usually much longer on slower systems.

Bringing a computer back to life after a hard drive crashes or becomes corrupted is a similar job. If the hard drive does not need to be replaced, it will at the very least need to be re-formatted and have the operating system reloaded. Again, this is at least a half hour of work. And usually even more time is required to load all the hardware-specific drivers after the OS is installed and running.

While most computer-savvy individuals can afford to spare an hour or so to set up or restore a new or ill computer, people that have to deal with new and dead systems day in and day out clearly need a better way to do it. Companies that put together and sell new PCs wouldn't be able to sell that many of them if it were so time-consuming to set them up. So how is it normally done?

Drive Cloning

The fastest way to get a new or refurbished PC up and running is to install a hard drive that has an operating system pre-loaded on it. As an example, say a computer store has 100 identical new systems that need to be set up. A technician at the store would simply set one system up, make sure it's perfect, clone the hard drive 99 times (make 99 duplicate drives), and then install a drive in each system. If all goes well, a new system will boot right up with the same configuration as the first one.

Drive cloning is also useful for fast disaster recovery. If the hard drive of a freshly set-up system is cloned, and the clone drive put away for safekeeping, it is a simple matter of swapping out the drives should anything ever go wrong with the first one. Of course, cloning a hard drive is not as simple as typing "Copy C: *.* D:" at the DOS prompt—nothing is ever that simple. There are many intricacies involved in copying a hard drive, hidden partitions being one good example.

Image MASSter SOLO

Though there are numerous hard-drive cloning solutions on the market, one very portable and affordable solution is Intelligent Computer Solutions' handheld Image MASSter SOLO. This hard disk duplicating device is a portable unit with storage space inside it for a master hard drive to be used for setting up new or trashed drives. The Image MASSter SOLO costs $795.

This handy device can even be used to set up or restore hard drives that are already installed in a system. In that case it works through the parallel port, so the system doesn't have to be opened up. So even if the PC is buried under a pile of junk, you'll still be able to restore its hard drive without removing the cover. The data transfer rate through the parallel port can exceed 300 MB/minute.

The Image MASSter SOLO can copy to both IDE and SCSI drives, something that not all drive cloners can do. It also works with any operating system and application software including Windows 95/98, NT, SCO, Unix, OS/2, and Mac OS. The master and target drives can even be different sizes and models, which eliminates a lot of hassle. The Image MASSter SOLO also supports those hidden Compaq-specific partitions and notebook-suspend partitions.

Although it is easy enough to set up a master drive for each of several different system configurations and use whichever one is necessary for a given system, that can be expensive, depending on how many master drives are needed. It's also a pain in the neck to travel around with all the different master drives. ICS's optional software, called Multi-MASSter, eliminates the need for all those drives.

Multi-MASSter allows up to ten disk images to be stored on a single master drive, provided that the capacity of the master drive is large enough to store all of the images. Multi-MASSter works with DOS, Windows 95, and Windows NT, but only for FAT-based disk configurations—NTFS users can't use the Multi-MASSter option. Another software option, NTFS-IQcopy, allows NTFS-formatted drives to be copied. A third software option lets hard drives be erased, or "sanitized," to the Department of Defense DOD 5220-22M specification.

Older hard-drive duplicators would generally copy each and every sector of a hard drive, regardless of whether there was data in them or not. That was one

reason why it used to be necessary to clone one drive to an identical one. But the Image MASSter SOLO features automatic load-size detection where only areas of the master drive that contain data are copied—empty sectors are skipped. So, regardless of whether the target drive is smaller or larger than the master, the target will be properly formatted and its partitions properly scaled before being loaded with the master-drive image.

Faster Still

Parallel-port disk duplicating is certainly convenient, but the Image MASSter SOLO offers a much faster way to copy drives: an IDE connector for direct connection to IDE drives. Of course, the drives have to be removed from a system before they can be cloned or restored using the direct IDE link. This works for IDE, EIDE, and Ultra DMA drives. SCSI drives can only be copied using the parallel-port option. Direct IDE copying works at speeds up to 400-MB per minute, depending on the speed of the hard drives used.

The Image MASSter SOLO can be powered by the included AC adapter or directly from the target PC's hard-drive power source. Desktop systems have no trouble supplying power to the Image MASSter SOLO, but you wouldn't want to do that with notebook computers.

When used with the direct IDE connection, the Image MASSter SOLO offers the same features of all Image MASSter drive duplicators including safety functions such as Drive Info, Verify, Remainder-Check, and Safe Mode to ensure flawless copying.

ICS offers various accessories for the Image MASSter SOLO to make the unit more versatile. Options include notebook hard-drive adapters and PCMCIA adapters, as well as a lightweight, padded carrying case.

Hooking It Up

The Image MASSter SOLO comes in a beige steel enclosure with storage space in the lower part of the unit for housing a master hard drive. A small LCD display and six function buttons are used to control everything. The unit features external parallel and IDE ports for attaching drives, and a serial port for installing SOLO software upgrades. A DIN-to-PC adapter allows power to be supplied by the computer that is being worked on.

Hard drives that are not installed in a system are connected to the drive duplicator using included IDE and power cables. Then everything is controlled from the SOLO control panel through a series of menus. Status indicators include a blinking green "OK" light and solid red "error" light.

Connections to drives that are installed in systems are made using the included parallel cable. If the parallel connection is to be used, the supplied client software must be installed on a boot disk that will be loaded in the system that will be connected. The client software provides on-screen indicators as to progress, performance, elapsed time, and so on.

Powering up for the first time requires that the user enter any optional authorization codes supplied by ICS—the codes basically "unlock" whatever features a particular user has paid for. Extensions become permanent once they are installed.

You don't have to be a rocket scientist to operate the Image MASSter SOLO, but those unfamiliar with computers and hard drives should probably avoid cloning them. You do have to know what you're doing, but if you do, the SOLO can make your work a whole lot easier and faster. And its price of $795 is actually cheap when you consider that it can store up to 10 different hard-disk images on a single master hard drive—that alone can save several thousand dollars versus having to have several different image disks. It also lets you set up or restore computers in a breeze, leading to bigger profits. For more information on the Image MASSter SOLO, contact Intelligent Computer Solutions (9350 Eton Ave.; Chatsworth, CA 91311; Tel: 800-545-5447; Fax: 818-885-6769; Web: www.ics-iq.com) directly, or circle 15 on the Free Information Card. EN

PHONE ADAPTER

(continued from page 87)

PARTS LIST FOR THE PHONO ADAPTER

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1, R5—1 megohm
R2, R6—75,000-ohm
R3, R7—6,800-ohm
R4, R8—1500-ohm

CAPACITORS

C1, C3—3300-pF, ceramic-disc
C2, C4—1000-pF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

J1–J4—RCA phono jacks, panel-mount
Audio cables, case, grommets, hardware, etc.

but to most ears, 10% ceramic capacitors and 5% carbon-composition resistors are acceptable. For fussier audiophiles, using tighter-tolerance components or hand selecting component values are ways to get the best accuracy. Additionally, the use of metal-film resistors will minimize any audio noise created by the Phono Adapter.

It is not necessary to use the component values indicated for your adapter network. Table 1 shows a few design alternatives in terms of component value. If you have these complete alternate-value sets lying around in your spare-parts box, the Phono Adapter will become that much less expensive to build!

If you notice that playback is too loud or soft compared with other stereo inputs, the attenuation provided by R3, R4, R7, and R8 may be modified, as long as the sum of the two resistors are kept constant. That changes the signal level without altering the frequency-response characteristics. Preamplifier gain variation in different models of receivers might make this "tweaking" necessary.

Happy listening! Ω

BY DON LANCASTER

SETI at Home, Hot-Tub Economics, and More

BY NOW, YOU HAVE PROBABLY GOTTEN THE WORD THAT THE SETI-AT-HOME RESEARCH HAS REALLY TAKEN OFF; FULL DETAILS ARE AVAILABLE AT WWW.SETIATHOME.SSL.BERKELEY.EDU. IN JUST THEIR VERY FIRST DAY OF OPERATION, CENTURIES of computing power were turned loose on an advanced search for extraterrestrial intelligence.

This seems to be an exceptionally well-designed experiment in parallel computing. Each volunteer gets some screensaver software and just under half a megabyte of data. When the volunteer's computer is not busy doing anything else, SETI's data is digitally filtered and then returned to them.

The processing normally takes 24 to 36 hours of computing time. The Fourier-related coherent algorithms seem ten times better than anything ever tried before. Only unused computer time is diverted. All the ongoing "winners" appear on top twenty video-game style "high score" listings.

This program frees the big Arecibo radio telescope in Puerto Rico to stay busy doing a full sky survey for another long-term project. The SETI data is just slurped off of a parallel feed at essentially zero added cost.

The main survey is parked at the usual "water hole" in the microwave region. There is both an atmospheric window and fairly low noise between the hydrogen molecular resonance at 1420.406 MHz and three of the hydroxyl resonances at 1621.231, 1667.359, and 1720.530 MHz. More information on molecular resonance appears in MUSE118.PDF on www.tinaja.com.

For these and other reasons, this frequency band is thought to be good ET territory. This particular search centers on the 1420.406-MHz hydrogen resonance. As Fig. 1 shows, a band from 1418.75 to 1421.25 MHz is recorded. That data is sliced up into 250 frequency bands.

Each volunteer gets several hundred seconds worth of the 10-kHz bandwidth work unit to filter. Fancy coherent filtering looks for the energy in every work unit. Likely targets should have stronger energy at one frequency than another. Useful energy should also rise and then reduce over twelve seconds in a Gaussian manner as the sky is swept. Finally, valid signals should also chirp or sweep slightly in frequency. The latter Doppler shift is caused by the target planet's motion.

At this writing, SETI at home has distributed over a million work units and has gotten a third of them back, racking up well over a millennium of computing time, which obviously seems to be well beyond human brain capability—by bunches. No, ET has not reversed any phone charges yet. But the real truth and

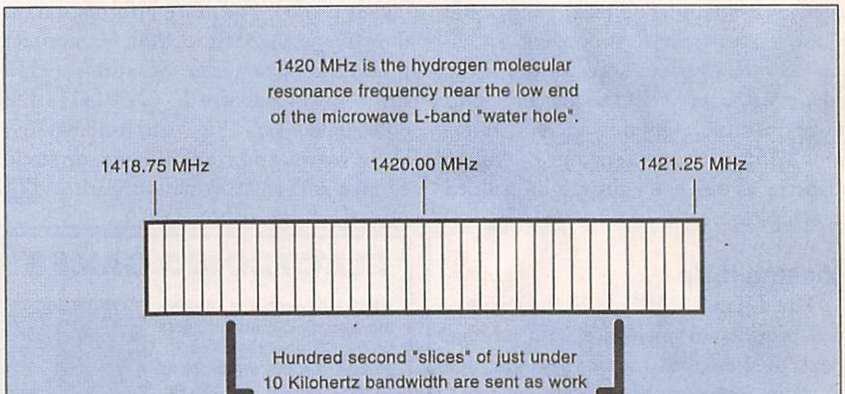


FIG. 1—THE SETI-AT-HOME project monitors frequencies near the hydrogen molecular resonance at the low end of the "water hole." When you participate, you get a screensaver that background filters a few hundred seconds of a 10-kHz work unit. Processing usually takes 24 to 36 hours. Many millennia of computer time have already been completed.

NEED HELP?

Phone or write all your US Tech Musings questions to:

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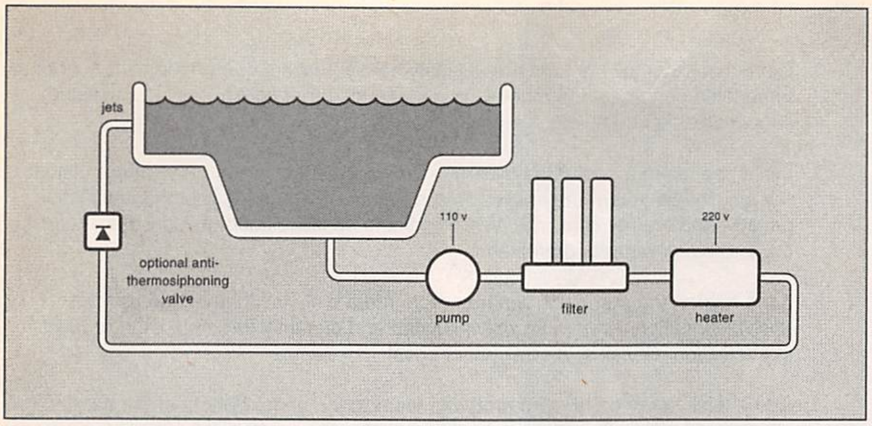

FIG. 2—A TYPICAL HOT tub setup.

beauty of this fine program lies in its proven ability to bypass funding and bureaucratic hassles while delivering amazing computing power.

A listing of a several useful radio astronomy books has been added for you as this month's resource sidebar. I expect to see lots more Web-based intensively parallel computing projects showing up—stuff that can get results ridiculously faster for a negligible fraction of government lab-research funding rates—and free of hidden agendas.

I've been wondering if this same stunt might not be appropriate for my magic sinewaves. New candidates are taking 40 to 50 hours per amplitude these days. Seems there are a lot of possible 768-bit words, and the real goodies appear to lie in those scary uncharted nether regions beyond. A definitive catalog sure would serve as a useful resource. More details up at www.tinaja.com/magic01.html. Let me know if you want to work with me on this.

Hot Tub Economics Review

I recently finished repairing and upgrading an older hot tub. I got to thinking about just what can be done to reduce operating costs and shorten warm-up times.

A "typical" older hot tub installation is shown in Fig. 2. Water flows from the tub through its pump, a filter, a heater, and back into the tub again in a closed loop. Typical temperatures are 102 degrees for socializing and 104 or even 105 degrees for mild therapy, with possibly 108 degrees for brief and intense therapy. The temperature regulation thus should be strictly held under one degree, if possible.

Heaters can be wood, solar, natural gas, propane, resistive electrical, or heat pumps. Wood and solar both tend to end up maddeningly difficult to tightly regulate to the temperatures needed. Gas or propane is usually the cheapest when available. Heat pumps specifically for hot-tub usage are still outrageously expensive, and they also drop in efficiency when cold. Thus, 220-volt resistance heaters usually end up as the norm.

My particular older "warmer-upper" consisted of a pair of 6-kilowatt immersion heaters. Because a cheap mechanical thermostat cannot work with less than a five- or a ten-degree ΔT, a "bypass" scheme is used: Only a fraction of the water actually goes through the heater. Thus a ten degree ΔT thermostat holds to one degree, on the average, if it is only heating one tenth of your total water.

This heater design had some other bad habits: All the thermostats only loosely leaned up against their steel case, leading to slow cycling and a poor warm-up time, which was caused in part by the thermostat having to slowly cycle during much of the warm-up time.

Some Numbers

Let's head back to the science books: A BTU, or British Thermal Unit, is the amount of energy it should take to raise the temperature of one pound of water by one degree Fahrenheit—or roughly the chemical energy in one large kitchen match. There are 3413 BTUs in one kilowatt-hour of electricity, or 0.2930 watt-hours per BTU.

The pounds of water, of course, depends on the size of the hot tub, but for a 6-foot, 8-inch hexagon hot tub, something under 500 gallons should be a usefully conservative estimate. For exact numbers, note that there will be 7.5 gallons or 63.4 pounds of water in a cubic foot, and then calculate your actual volume (or else carefully fill your tub

five gallons at a time).

Figure on roughly eight pounds per gallon for a total of 4000 pounds and 4000 BTUs per degree of warming. Or, at a cost of ten cents per kilowatt hour, 1171 watts per degree (say twelve cents per degree).

How much heating you will need depends on how much the tub cooled since your last use. A cold warm-up from 60-degree water to 102 degrees requires at least 40,000 BTUs to the tune of $5. A second-day re-warming in a tub that has cooled off by eight degrees costs around $1.20 per day, $36 per month, and $432 per year.

Curiously, running your tub every second day costs you about the same as using it daily. You might lose ten degrees during the first day and only seven or so during the second. Thus, repeated tub use is nearly "free."

In the absence of heat losses, twelve kilowatt-hours of energy should raise your hot tub temperature at a rate of ten degrees per hour. Hot-tub heat losses can come from conduction, convection, or radiation. The secret is to keep as much heat in the tub as you can between uses. Conduction will be proportional to temperature differentials, while the radiation starts off much weaker but shoots up with the fourth power of temperature difference. Thus, it will always be better to heat immediately before use—every time.

The most important barrier to heat loss is a good two-inch thick insulating cover that fits tightly and is kept on when not in use. It should preferably be a split folding cover that need not always be totally removed. A second inner floating cover might also help.

A thick coating of urethane foam on the underside of the tub is also a good idea. This extra process during installation can make a big difference and easily pays for itself. If the pump, heater, pipes, and filter are remote from the tub itself, those should be kept at the highest possible temperature and well insulated from wind and night-sky radiation.

Certain larger hot tubs might also "thermosiphon" during non-use times; in other words, the warmer water rises, runs slowly backwards through the filter and pump, cools down, and wells up from below. That was definitely a problem for me on very cold nights. I fixed it by adding a $9 one-way valve "diode" from the hardware store. The valve is best placed in a non-obvious high side position after your heater; if it is located elsewhere it might interfere with pump priming.

Siting:

0. Remember that full hot tubs are insanely heavy. Placing one on the third floor of a remodeled century-old farmhouse is a no-no. Older or lighter deck installations should also be structurally reviewed.

1. Install the tub in a separate building or atrium or whatever that is neither outside nor fully inside your living space. This is required for humidity control, ventilation, privacy, and energy efficiency. While avoiding possible flood, mildew, rust, scorpi on, termite, or other bug problems.

2. If the heater and pump are separate from the tub, install them in the warmest possible location. Preferably well insulated and certainly free from wind or night sky radiation. Consider a solar panel boost.

3. Add a thick spray-on layer of urethane foam to the under bottom of the tub and to all exposed pipes. Provide a two- or three-speed pump that only slowly circulates water during initial heating. Use an oversize filter for reduced pressure drop. Provide a high side anti-thermosiphoning valve if one seems to be needed.

4. A thick and flat folding insulated lid is a must. One that provides a skirted and solid seal all the way around. A second floating inside cover can also be worthwhile.

5. Avoid "bypass" style heaters with high differential DT mechanical thermostats. Make sure the thermostat time constant is sufficiently low. Also that excessive cycling does not take place coming up to working temperature. If possible, sense the temperature electronically inside the tub itself.

6. Carefully plot and record your heating rate of rise and your cooling rate of drop. Do so for all seasons. If you lose more than eight degrees per day, find out why.

Use:

1. Turn the tub on just soon enough to come up to use temperature. Provide a timer or other intelligent control to prevent running unused. Use your rate-of-rise plots to determine warm-up time. Then adjust as needed.

2. Remove the cover only during use. Flip back only half of the cover when you are using the tub by yourself. Do not ever let a cover get waterlogged.

3. Keep and use a tub thermometer. Use the minimum temperature appropriate for the intended tub use. A heater override switch is often a good choice.

4. Use air bubble injection only when the effect is specifically being enjoyed. Blower air is especially energy wasteful. Blowers also tend to be excessively noisy.

5. Using a hot tub a second day in a row is nearly "free".

FIG. 3—SOME RECOMMENDATIONS for hot-tub energy efficiency.

Does your pump add to the heat? In the absence of losses and running full tilt, a two-horsepower pump should warm the water about the same as a 1.6-kilowatt heater does—around one-sixth of your total input energy. But the pump rarely runs full power, and the circulation losses sap some of that heat.

The pump itself would seem to add only a modest amount of heating at best. On the other hand, when your old heater is taking its good old time about temperature cycling, much of your pump energy is largely wasted, perhaps to the tune of fifteen cents per warm-up hour—possibly by as much as $200 or more per year. Thus, we have got a second reason besides convenience for very rapid warm-ups. A two-speed pump is best here—one that only moves the minimum amount of circulating water needed during the heat-up process.

What about air injection? "Cane air" or any "venturi" cools your water moderately by bubbling much colder room temperature air through it. But blower-powered bubble machines dramatically cool off your water. An obvious rule here is to only use costly air injection whenever somebody is actually enjoying its effects.

Measuring Gain and Loss

Two things that are very important to measure here: The hourly warm-up rate of rise and your daily rate of cooling. Any old thermometer can be used for this. Plot temperature versus time on a graph, although some extra precision will be needed if you want to measure exact BTU losses.

By measuring the warm-up rate, you will be able to turn on your tub exactly for the required heating time. And by knowing the cooling losses, chances are you can reduce them by finding their cause. The figures change somewhat with the seasons and the exact water level, but those factors are easily adjusted for.

Some hot-tub energy-conservation suggestions appear in Fig. 3. You can decide which of those are or are not convenient or cost effective for your own use. Many newer tubs have improved thermostats, under-tub insulation, slow warm up re-circulation, and similar energy improvements.

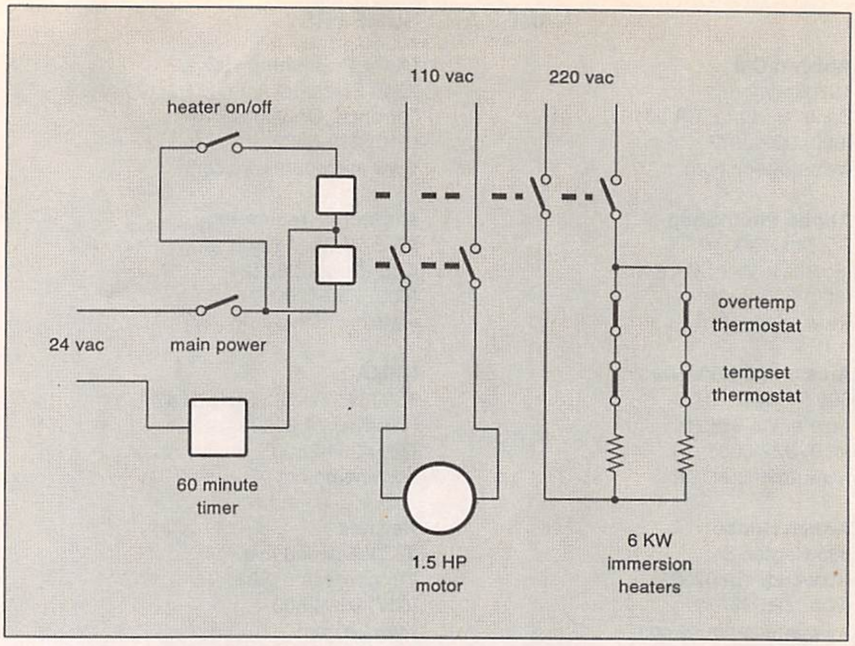

FIG. 4—A POSSIBLE WIRING DIAGRAM for hot-tub experiments. Thermostats are purposely set slightly high and overridden with a manual heater switch. Operating costs dropped dramatically in the author's setup.

An Intelligent Controller

As an experiment, I modified the control circuitry for my hot tub as shown in Fig. 4 so I could turn the heater off and on manually, but only when the pump is running. I then cranked the thermostat settings way up, being careful to keep those over-temp safety sensors in place.

Warm-up time dropped dramatically, operating costs went down (caused mostly by the pump running less), and a few heat cycles that did not do anything useful were eliminated. Sadly, I did have to carefully pay attention to precisely how long this forty minute warm-up took. A simple $19 mechanical timer might prevent waste here. I selected an Intermatic FD60MC, available in most hardware stores. Check out their useful Web site at www.intermatic.com

Also note that hot-tub electrical safety is very important, so lower voltage switching, GFI, or pneumatic remotes are a must.

A better route, of course, would be a custom intelligent controller. First, you'd put a decent electronic thermal sensor inside the tub itself—perhaps a Dallas DS16242 or similar device having a resolution of a tiny fraction of a degree and a circulating-water time constant of a second or two. Feed that to a Basic Stamp or a custom PIC that knows the inside and outside ambient temperature, the time of day, whether the lid was off, the heating and cooling rates, and your favorite use time.

The controller would then use the tub temperature and its heating rate to anticipate when you want to use the tub. It would then turn the tub on somewhat earlier, applying full heat to bring the tub up to just under your favorite temperature.

When it hits the desired temperature, it would switch to an ultra low power "maintenance" heating mode that would be held so long as the lid still remains on. Or, better yet, the tub shuts down after an hour or two just in case you forgot or changed your mind. During its "use" mode, heat power would be adjusted to hold the desired temperature more or less precisely.

Imaginative Images

Getting full color images up onto Web sites is a big deal these days. It's being done for everything from an auction up at www.ebay.com to your own Web site sales pages. However, because so many of the images on the Web look so bad, you can definitely gain an advantage by making all of yours first rate.

For smaller banner ads and other places where lettering is important, the GIF format is probably best. But for just about everything else, JPEG is probably the way to go.

I've found an amazingly simple method to provide higher quality web "photography," one which seems to give superb results. You simply start using a scanner as a camera.

The advantages here are that you get outstanding resolution combined with exposures, distortion, focus, and lighting that are right on. You now can also work directly with bitmaps. This gives you scads more sharpness and eliminates lots

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of generational editing artifacts. Unfortunately, because bitmaps gobble up memory at a prodigious rate, a CD-R drive is a must.

The available depth of field on my Hewlett Packard Scanjet 6100C is utterly amazing. Disadvantages are that you have a "flat" view; there are obvious size limits; and parts of the object further from the glass may end up much darker.

I will start by setting a piece of test gear on the scanner bed. Erasers are placed under critical edges to get all of the knobs stable and flat. These supports can easily get edited out later. Be sure to have the object's main surface precisely flat and parallel with the glass.

It is extremely important to use a machinist's combination square to exactly line up your subject with the scanner. Try for a one pixel accuracy if at all possible.

Colored paper then is positioned behind and around the subject, trying to get as close as possible without any cropping. Zooming and enlarging somewhat will usually give you a picture that ends up "full size" at higher monitor resolutions.

After scanning, I send the picture to plain old Paint. The brightest portion of the background is then selected for a masking standard. You then can mask background to subject, suitably blending (anti-aliasing) on diagonals. Other tricks such as removal of supports, scratches, or blemishes are easily done. Shadow improvement is another possibility here.

Finally, the bitmap is cropped, brightened, sized, gamma corrected, and converted to JPEG with Arcata's ImageViewer or some similar utility. Adobe's PhotoShop, of course, is one other obvious possibility.

Most images can be improved with modest increases in both brightness and contrast, plus a gamma adjustment.

I'll normally zoom somewhat with the scanner. This gives you a normal sized display on a higher-resolution monitor. I tend to keep the JPEG file sizes in the 100K range for sharp lettering. Larger images should click expand on user command only.

A tutorial with more detail is up at www.tinaja.com/blat01.html. The actual images can now be found at www.tinaja.com/barg01.html. Custom services are also available.

New Tech Lit

From Microchip Technology comes a fresh *1999 Technical Library* CD ROM including details on their new PIC18 CXX2 high-performance chips. More on the PIC micros in general is at www.tinaja.com/picup01.html.

From Texas Instruments, there are data booklets on the TLC32AD50 and the TLC320AD75 sigma-delta chips. The former for low speed instruments, the latter for stereo A/D. From Tritech, lots of interesting new data sheets, such as a TR83100CF voice-storage controller, TR88L811CS touch-pad mouse controller, and their new TR88L803 pen-input processor.

A new Abbeon Cal publication has lots of thermal machines and related tools, books, and techniques of interest for plastic working. Industrial latches and fasteners are detailed in a new Zoom CD ROM from Southco.

Facts Finder is a quarterly GPS navigation publication from Trimble. Also newly updated is the *NEMA Electrical*

Standards and Product Guide. Mini-catalogs of specialized wireless and communications catalogs are newly available from Artech House.

Featured trade journals for this month are *Industrial Laser Solutions* by Pennwell and *Micro Publishing News* from Cygnusos.

Crash Course in PC Technology is the latest book in the Lou Frenzel series from Newnes. More details on this and similar texts can be found at www.tinaja.com/amlink01.html.

For insider secret details of active filters, check out my *Active Filter Cookbook*, as per my nearby Synergetics ad or else by way of www.tinaja.com/synlib01.html.

I have just added an ongoing live auction feature to my Web site up at www.tinaja.com. Simply click on that auction button for unbeatable surplus and other bargains. Our latest Blatant Opportunist tutorials include details on Web-site funding and useful e-mail etiquette. A number of classic Blats are also newly uploaded. Additional PostScript-as-language referral log utilities have also been added to my www.tinaja.com/post01.html.

As usual, most of the mentioned resources do appear in our "Names and Numbers" or "Radio Astronomy Books" sidebars. Always check there before e-mailing don@tinaja.com or calling the no-charge voice help line found in the nearby "Need Help?" box.

Let's hear from you. EN

NEW LITERATURE

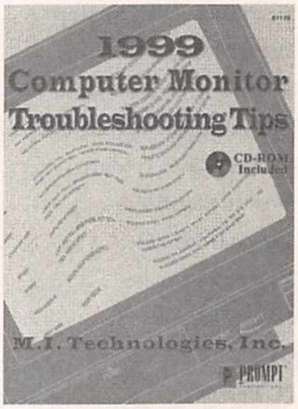
(continued from page 27)

1999 Computer Monitor Troubleshooting Tips

from M.I. Technologies, Inc.
Prompt Publications, Howard W. Sams & Company
2647 Waterfront Parkway, East Drive
Indianapolis, IN 46214-2041
Tel: 800-428-7267
Web: www.hwsams.com.
$49.95

With this guide, technicians can confidently tackle day-to-day monitor repair issues on site in a timely, efficient manner without having to go search for the schematic or tip needed. Troubleshooting tips include more specific details and instruction, with step-by-step guidance from point-to-point inside the monitor.

This manual is a comprehensive reference for anyone working on computer monitors. Over 3500 troubleshooting and repair tips are included, listed by manufacturer name and model number, such as Apple, Viewsonic, Packard Bell,



CIRCLE 345 ON FREE INFORMATION CARD

Compaq, Samsung, IBM. Sony, and many more. There are also schematics and parts lists for several models and an overview of VGA monitors and monitor EEPROM repair. The included CD-ROM contains M.I. Technologies' 1999 Windows Tech-tips demo monitor repair database, a complete listing of their schematics, and much more information.

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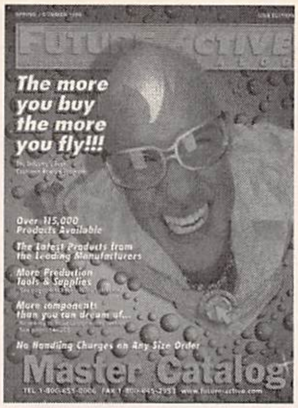
This 290-page catalog offers a wide selection of the over 115,00 products that Future Active supplies. Production tools, such as test and measurement instruments, datacom and telecom products, workstations, microscopes, and ultrasonic cleaning system are included. Components such as connectors, diodes,



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transistors, switches, heats sinks, and fans are listed. Among the manufacturers represented are Fluke, Extech, Protek, Serpac, Pomona, and NTE.

Products are indexed by manufacturer and product name, and there is also a components parts number index. Full-color photos and specs accompany the listings. EN

ANTIQUE RADIO

(continued from page 23)

encouraging hum from the speaker.

With an antenna of perhaps six feet laid on the floor of my office and no ground, I was able to pick up a number of stations all over the tuning dial. Volume control was smooth and noiseless, indicating no problems caused by my having restored the original wiring. However, the sound seemed a bit sharp, even considering the ancient technology used to produce it. When I cut in the "bass" capacitor using the two-position tone control, the sound obediently dropped several octaves in pitch. However, it became so muddy as to be virtually unintelligible.

We'll have to check on the sound problem next. I want to take a look at the grid bias on the 47 output tube, and I'd also like to have the speaker reconed. The present cone is perfectly intact, but has been treated with so many coats of speaker cement that it is very stiff. Also on the docket for the next couple of columns is cosmetic cleaning of the chassis top, realignment, and (definitely my least favorite activity) cabinet refinishing.

In the meantime, your comments and queries are always welcome. Write me c/o **Electronics Now**, 500 Bi-County Blvd., Farmingdale, NY 11735 or e-mail me at mfellis@enteract.com. EN

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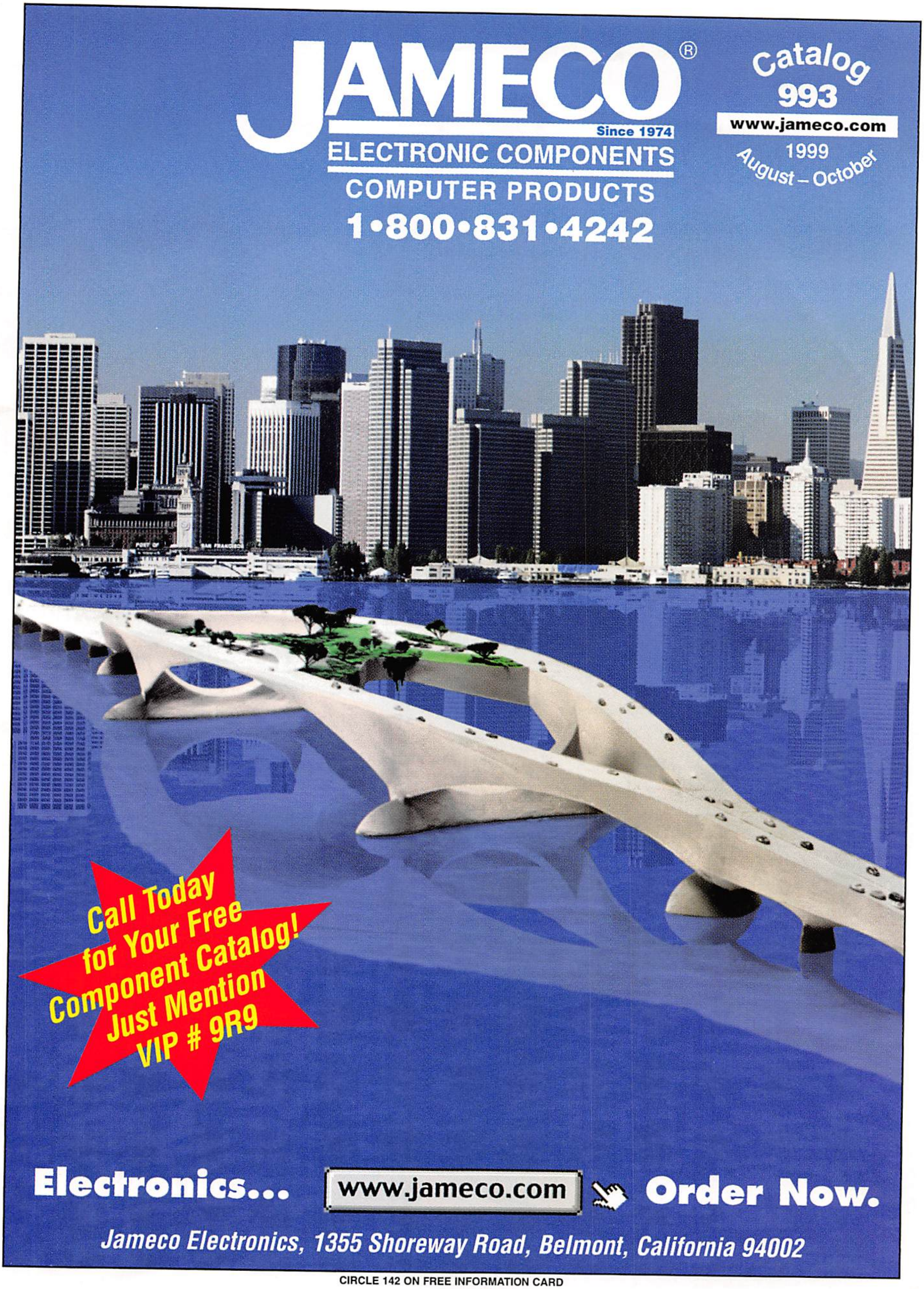

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